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10

The Limits of Universality

How Field-Specific Epistemic Conditions Affect Authority Relations and their Consequences

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1. The Field-Specific Nature of Authority Relations

Any account of the impact of changing authority relations on scientific research must consider differences between fields of research. Three kinds of variation can occur. First, authority relations themselves can vary between fields. For example, actors with commercial interests have little or no authority in fields that are remote from applications such as ancient history, pure mathematics, or high-energy physics. Ethics committees exercise considerable authority in fields researching human subjects but not in others. Second, field-specific instruments for exercising authority may be used. The proposal to assess science, engineering, and medical fields by using quantitative indicators but to keep peer review for the humanities and social sciences in future rounds of the British Research Assessment Exercise is a case in point. Third, authority relations may have different effects in different fields depending on the practices of a field's research, as for example demonstrated by Chapter 8.

Such field-specific modifications of authority relations and their effects have been common knowledge in science studies for a long time. The differences between research practices and social structures of scientific disciplines have been explicitly addressed in several influential theories (Whitley 1977, 2000; Rip 1982; Böhme *et al.* 1983). However, the role of these epistemic conditions is rarely taken into account when governance instruments are designed or investigated. Most instruments for the

governance of science are applied across several if not all fields in the natural sciences, social sciences, and humanities, and are intended to have the same effects in those fields.

This logic underlies the research evaluation systems that have been established in many countries during recent decades (Whitley and Gläser 2007; see also Chapters 2, 5, and 8). A similar blind spot exists in studies investigating governance regimes, which ignore the impact of epistemic conditions on governance by (*a*) including only one field (for example, Meulen and Leydesdorff 1991; Morris 2000; Sousa and Hendriks 2007), (*b*) investigating several fields and only distilling results that are common to all of them (for example, Henkel 2005), or (*c*) listing variations in effects without integrating them into the study's causal explanations (for example, Henkel 2000; Leišytė 2007).

In this chapter we address this gap of policy design and analysis by providing preliminary answers to two questions. (1) Which properties of fields and research practices modify authority relations and their effects? (2) Which mechanisms produce the field-specific variations of authority relations and their effects?

2. The Empirical Investigation

The empirical material we use to answer these questions stems from a comparative investigation aimed at identifying the impact of a specific governance instrument—indicator-based block funding of university research—on the content of that research (Gläser and Laudel 2007; Lange 2007; Gläser *et al.* 2008). Australia has the oldest and most consequential indicator-based funding regime for university research, and the adaptation of the actors in the university system to that regime could be expected to have systematic effects on knowledge production.

Investigating these connections required the solution of three major methodological problems. First, changes in knowledge production must be identified, which requires comparisons between knowledge production processes and their outcomes—including comparisons with those research processes that could not be conducted because of the governance regime under investigation. Secondly, if field-specific effects of governance instruments are to be identified, the changes in knowledge production must be compared across fields. Thirdly, the observed effects must be causally attributed to a specific governance instrument whose impact is overlaid by influences of numerous other instruments and organizational procedures. We developed the following preliminary solutions to these problems.

1. For the identification of changes in the production of knowledge we utilised the concept of research trails and additionally derived a list of possible changes in knowledge from the literature. Following Chubin and Conolly (1982) we defined research trails as sequences of projects that are thematically connected because later projects use the theoretical, methodological or empirical knowledge that has been produced in previous projects. We used a variety of empirical strategies for identifying the initiation, abandonment, and topical change of individual research trails. A second approach consisted of studying general features of research that are discussed in the literature as possible candidates for changes under political pressure: namely, the type of research conducted (methodological, theoretical, experimental, or field research); the dominant research orientation (basic, strategic, or applied); the relationship to the community's majority opinion (non-conformist versus mainstream); time horizons (long-term versus short-term); the degree of interdisciplinarity; the degree of intellectual risk taken in the research; and the reliability of results (Gläser *et al.* 2002).

2. We conducted comparative case studies that used the general properties of research listed above, and selected six disciplines for which these properties varied.[1] We included mathematics as a non-empirical science, physics and biochemistry as experimental sciences, geology as discipline whose empirical work is largely based on field observations, political science as a social science that encompasses both theoretical and empirical research, and history as one of the humanities with yet another specific empirical programme. These disciplines also vary in another important property, namely their reliance on expensive equipment and additional manpower and thus their demand for external funding. In order to advance our understanding of field-specific properties and their modification of governance, we included two ethnographies: one in history and one in biochemistry.

3. A causal attribution of changes in the production of knowledge to the governance instrument under investigation can be achieved by specifying the social mechanisms that link the particular governance instrument to

[1] We could not draw on the theoretical approaches mentioned in the Introduction because they have not yet been (and probably cannot be) operationalized for empirical investigations. The approaches based on the constructivist sociology of scientific knowledge such as Actor-Network-Theory (Callon and Law 1982; Callon 1986; Law 1986; Latour 1987, 1988, 1996), the 'Mangle of Practice' (Pickering 1995), and 'Epistemic Cultures' (Knorr-Cetina 1999) are not of much help either because they combine idiosyncratic descriptions with 'grand theories' that do not support comparative frameworks.

these changes.[2] This we achieved by conducting nested case studies (Patton 2002) and comparing cases at all levels of our multi-level problem. At the level of national systems of university research funding we compared Australia to Germany, which at the time of the investigation (2003–7) was just beginning to introduce performance-based funding schemes for its universities, and was thus ideally suited as a 'reference measurement' of research not yet affected by performance-based block grant allocation. At the level of universities, we included seven universities from different strata of the highly differentiated Australian system and two German universities.[3] We also compared organizational sub-units (faculties and schools) in and across universities, and individual academics at different stages of their career from lecturer to full professor.

Data collection was conducted from 2004 to 2007. It combined analysis of documents and internet sites, bibliometric analyses, qualitative interviews as the core method of the case studies, and focused ethnographic observations. In Australia, a total of 179 interviews were conducted, including 61 interviews with managers at university, faculty, and school levels and 118 interviews with academics from the six disciplines and all career stages. German interviews included twelve interviews with managers and sixty interviews with academics (professors, their associates, and post-docs). Interviews with managers lasted 45 to 90 minutes and covered perceptions of funding conditions, the impact of the national and internal funding schemes on the core functions of the university (teaching and research), and university strategies for the internal governance of research, with special emphasis on performance evaluation schemes for organizational units and academic staff that are currently in place.

Interviews with academics lasted one to two hours. Following the theoretical considerations described above, the interviews addressed research trails, conditions for research, and university policies concerning these

[2] We define a social mechanism as *a sequence of causally linked events that occur repeatedly in reality if certain conditions are given and link specified initial conditions to a specific outcome* (see Mayntz 2004: 241; for similar but less precise definitions, Merton 1968: 42–3; Hedström 2005: 11). By identifying a social mechanism we demonstrate *how* a specific cause—in this case a governance instrument—produces changes in research, which in turn implies causally attributing these changes to the governance instrument. See Whitley (1972) for an application of the concept of mechanisms in science studies.

[3] Our sample included three members of the 'Group of 8' (research-intensive universities, most of which were founded before the Second World War), two 'Gumtree Universities' (post-Second World War foundations that are well established but less research-intensive), and two 'Universities of Technology' which are smaller and focus on applied research.

conditions. In order to go beyond the opinions of academics about the impact of their research conditions on the content of research, these two topics were clearly separated in the interviews. All interviews began with an extended exploration of interviewees' research trails and reasons for initiating, abandoning, or changing them. This part of the interview was prepared by bibliometric analyses of the interviewee's publication oeuvre, whose visualization was used in the discussion of continuity and reasons for changes of research trails. Only after the cognitive dynamics and the specific resource requirements of the interviewee's research were established, the actual conditions for research, including access to resources, behavioural expectations, and university policies, were explored. Ethnographic observations (in history and biochemistry) focused on field-specific epistemic practices and the impact of everyday activities on the conduct and content of research (see Gläser and Laudel 2007, 2009*a*, for a more detailed description of the methodology).

Data were analysed by qualitative content analysis (Gläser and Laudel 2009*b*). Cases were compared at all levels described above. The following analysis of selected results focuses on the Australian case. Results from the 'reference measurement' in Germany are included where appropriate.

From our empirical results we select those that can be used for a discussion of authority relationships and their effects in different fields. For this purpose we use the following aspects of our data analysis:

- For the discussion of field-specific uses of instruments for exercising authority, we used the categorization of governance tools according to their purposes (resource allocation, deciding on and introducing structural changes, distribution of workloads among academics, and individual performance management) and effects. We could not directly observe the role of field-specific instruments for exercising authority because the same instruments were applied in all fields. However, our analysis of the use of uniform instruments in all fields enables indirect conclusions about the role which field-specific instruments might play (section 3).
- The discussion of field-specific authority relations is based on the comparative analysis of academics' research conditions across the six disciplines. Since we had to embed our analysis of the effects of a specific governance instrument in the analysis of researchers' situations in their full complexity, we obtained data on authority relations concerning the formulation of goals and integration of results in the six disciplines under investigation (section 4).

- The identification of field-specific effects of authority relations is based on the analysis of academics' responses to their situation. We compared the content of and reasons for adaptation processes in the six disciplines. Particular attention was paid to the ways in which academics managed their 'research portfolios' (the bundle of actual and potential research trails they could follow) and the ways in which shortages of time and resources were responded to (section 5).[4]

The most interesting question of all is, of course, that about the causes for field-specific effects. Even though this was not the major focus of our investigation, we could draw some tentative conclusions about epistemic properties of fields (section 6) and their role in the mechanisms that produce field-specific effects (section 7).

3. Exercising Authority by Using Uniform Instruments

Authoritative agencies might use different instruments for exercising authority in different fields because instruments that are adapted to the specific conditions of fields are likely to be more effective. In our investigation we analysed instruments for distributing research funding that were applied to universities, within universities to faculties, and within faculties to schools. The different levels of aggregation represent different degrees of homogeneity of the (collections of) fields to which the instruments were applied.

Since funding instruments are likely to have different effects in different disciplines, one would expect both a variation between instruments applied at different levels of aggregation and a variation between the

[4] The comparisons of adaptation processes had to take into account a further intervening variable, namely the performance levels of the interviewed academics' research. Adaptation processes and their content are likely to depend on performance levels, which means that findings concerning field-specific effects are obscured by performance-dependent effects. In order to control for these influences, a variety of indicators and information from interviews was used to roughly categorize academics according to their performance levels. Since this is an inherently problematic exercise, we used as many indicators as possible and varied categorizations in order to test the robustness of our analysis. We included, where appropriate, numbers of publications, qualities of journals, book series, and publishers, citation counts, grant funding from competitive sources, reviews of books published by interviewees, and indicators of esteem such as memberships in editorial boards, invited lectures, and academic prizes and awards. We also included aspiration levels and research plans, which were covered by the interviews. On the basis of the categorization, we checked whether interview data from 'better' performing researchers were systematically different from those obtained from others (see Gläser and Laudel 2009*a*, for a detailed methodological discussion of the inclusion of informants' performance levels in qualitative science studies).

Table 10.1. Degree of disciplinary homogeneity of recipients of research block funding at different levels of aggregation

Authoritative agency	Recipients of funding	Degree of homogeneity
Government	Universities	Including all disciplines
Central university management	Faculties	Including similar disciplines
Faculty	Schools or departments	Including one discipline

instruments applied in different disciplinary environments; that is, by different faculties. Neither was the case in the seven investigated Australian universities. Instead, the national system of indicator-based block funding was copied by authoritative agencies at all levels.

National Level

In Australia, the block funding for university research has been transformed in an indicator-based system from the mid-1990s. Currently, a system of four indicators controls the allocation of the research block grants. In 2005, 1,135 million AU$ (7.9 per cent of the total income of universities) were allocated according to competitive peer-reviewed external grant funding (weight of the indicator 54.8 per cent), Masters and Ph.D. completions (29.1 per cent), numbers of publications (8.4 per cent), and research student load (7.7 per cent). The allocation is a zero sum game; that is, a university's share of the research block grants depends on its shares in the total numbers of publications, total amount of external funding, and total numbers of research student loads and completions of all universities.

These indicators are applied to all universities and thus to all disciplines. They obviously fit the research practices of some disciplines better than others. For example, in Australia only four types of publications are counted, namely peer-reviewed journal articles, book chapters, peer-reviewed conference contributions, and books (the last counting five times as much as the other publications). While these types cover the major output of many disciplines, they are by no means exhaustive. The Australian Government itself experimented with a significantly larger set of categories in order to accommodate, for example, the arts (by including works of art) and applied research (by including patents), but soon abandoned this approach for reasons of administrative convenience. As a result, the output of some fields is not appropriately covered, which in turn means that these fields do not 'earn research money' by publishing their results, regardless of the quality of their research. In our sample of disciplines, the most

pronounced examples were edited books, which play an important role in political science, and book reviews, which are an important means of communication in history (for a general discussion of this problem see Laudel and Gläser 2006).

A similar point can be made for the most important indicator in both Australia and Germany: external funding. The indicator 'external funding' is popular in science policy because it is based on peer review (of grant applications) and because data can be easily collected. However, disciplines vary enormously in their need of external funding and in the size of typical grants. The weight given to this indicator in Australia and Germany makes some disciplines (especially engineering and the experimental natural sciences) 'breadwinners' for their universities, while others do not contribute much to the income, regardless of their performance.

Thus, at least two indicators (among them the most important one) return discipline-specific results. Their application in national resource allocation schemes does not pose too serious problems because most universities combine all or at least all types of disciplines, which effectively desensitizes them to the biases of the indicators.[5]

University Level

The biases of indicators do have effects within universities because the Australian universities responded to their funding environment by applying the same indicators in their internal resource allocation schemes. The logic behind this move is simple: the universities want to maximize their income and thus use the same 'incentives' for their faculties and schools that are applied to them. At the same time, the decision to distribute resources 'as earned' is the one that is easiest to legitimize in the internal struggles for resources. The important difference between the external and the internal application is that the latter is an application to disciplinary units. Within universities, the indicators are effectively used to distribute resources between disciplines. In this situation, the above-mentioned biases against certain fields do make a difference.

Being aware of that fact or using it to legitimize redistributions, some universities respond by slightly changing the weight of the indicators. The

[5] However, the use of these indicators has led to a certain devaluation of the social sciences, arts, and humanities in Australian universities because these disciplines contribute comparatively little to the university's 'research income'.

three most research-intensive universities in our sample (the members of the 'Group of 8') modified their internal application of the indicators in order to limit disadvantages for the humanities. They reduced the weight of the indicator 'external funding' in their internal funding formulae and increased the weight of the indicators 'research student load' or 'numbers of publications'. One 'University of Technology' also reduced the weight of the indicator 'external funding' and increased the weight of the indicator 'publications' in order to foster a culture of publication. The remaining three less research-intensive universities (the two 'Gumtrees' and one 'University of Technology') used the indicators unchanged. In one of these universities it was explicitly stated that the humanities do not receive much money this way, but also do not need much.

Faculties, Schools, and Departments

At the next lower level within universities, the isomorphism repeated itself. If there was money for research to distribute, the faculties used the same indicators and weightings that were applied to them. Only one faculty changed the weights by again increasing the weight of research student completions and publications and decreasing the weight of external grant income. This faculty included experimental natural sciences and mathematics, and wanted to account for field-specific differences.[6]

Interestingly enough, even the relatively homogeneous Faculties of Arts or Faculties of Social Sciences did not radically change the weighting of the indicators, although they could have accommodated the specifics of their fields. Like all other actors, deans considered it paramount that the 'right'—that is, income-maximizing—incentives were given to the sub-units. This overriding concern made the Associate Dean of Research of one humanities faculty devise a scheme for individual performance evaluation that included only the indicators as they are applied to the university. He was fully aware of the fact that this does damage to his own discipline (he was a historian) because encyclopedia entries and book reviews were not counted in that scheme. However, he felt that maximizing income was more important.

[6] The differences between mathematics and the experimental natural science in the same faculty also became important in one faculty in Germany. The faculty had just begun to design a performance-based resource allocation scheme that completely disregarded the specific nature of research, funding, and publication practices in mathematics.

These marginal adaptations indicate that Australian universities are aware of the tensions between universal governance tools and field-specific research practices (not least because disadvantaged disciplines kept complaining) but nevertheless felt compelled to adopt governance instruments regardless of unfavourable conditions for their functioning. Apart from the universities' wish to transmit the external signals they receive to their sub-units and researchers, the reluctance to modify indicators may also be due to the general scarcity of funding for universities. The income of most universities just covered salaries and basic infrastructure. Under these conditions, it is difficult for universities to legitimatize internal funding schemes that deviate from the 'received as earned' principle. The overwhelming importance of scarcity is indirectly confirmed by the fact that adaptations of indicators are concentrated in the older and more research-intensive universities. Apparently, only the 'richer' universities can address the problem of biased indicators at all.

4. Field-Specific Authority Relations and the Situation of Academics

Any impact of our focal governance instrument—indicator-based block funding of research—on the content of research is mediated by the actions of individual academics, which reflect general changes in their situation rather than particular shifts in governance. Such changes are created by a variety of actors exercising authority over three crucial elements of researchers' situations: (*a*) their access to resources, (*b*) their discretion over time for research, and (*c*) behavioural expectations concerning their research. We begin by characterizing the elements common to all academics' situations, and subsequently explore (*d*) the resulting authority relations and their variations between fields.

Resources for Research

The resource situation of academics in Australian universities is characterized by the near absence of any recurrent funding for research. Many heads of schools stated that they do not have any resources for research to distribute, but need all the money they receive from the faculty 'to keep their school in the black'. Australian researchers do not commonly receive recurrent funding for their research, except for some who may receive 'a few thousand dollars in a good year'. The little money that was available for

research was centralized at the university and faculty levels, and was used either in the form of internal grants or for investments in infrastructure—both of which were aimed at improving the university's success in acquiring external funding.

This investment strategy was part of the response of Australian universities to the funding scheme described in the previous section. Internal resource distribution reflected the fact that the most effective means of increasing the block grant income of a university is to increase the external funding, which affects nearly 55 per cent of the government's block grants. Apart from copying the indicators and giving external funding a reduced, but still the highest, weight in their internal schemes, universities created sub-units that were likely to attract external funding and channelled the little internal funding they had to academics who were most likely to win external grants. The latter took the form of 'near-miss grants' and 'start-up grants'.

Australian funding councils informed universities about the relative success of failed grant applications. On this basis, universities gave internal grants to academics who came very close to being funded. These grants were not sufficient to conduct the actual research but enabled additional preparations that increased the likelihood of success in the following round of applications. The same motive made many universities offer 'start-up grants' to newly hired staff and to early career researchers. These grants should support the preparation of successful external grant applications. Recipients of these internal grants and the centres created by universities were envisaged as becoming 'self-sufficient' by entering a situation of continuous external grant funding.

None of the grants or infrastructure investments was sufficient for the planned research. Grants were limited to one year, were usually too small to hire staff, and did not include teaching relief. Thus, in many fields academics who received these grants found themselves in the same situation as the academics who did not receive any funding from their university: they crucially depended on external grants for conducting their research. This made the external funding landscape a very important condition for research.

The external funding environment of Australia is characterized by concentration and scarcity. The only major sources of funding are the two funding councils: the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). An applicant can hold no more than two funding council grants simultaneously at any time. There is little funding from other government agencies, charities, or

industry.[7] The success rates of ARC grant applications vary between 20 and 30 per cent for investigator-driven 'Discovery grants' and between 40 and 50 per cent for 'Linkage grants' which are co-funded by industry partners.

Time for Research

The time available for research was constrained primarily by teaching and secondarily by administration tasks. Teaching was evenly distributed between academics in teaching and research positions. Actual teaching loads varied between years because of the necessity to teach the required courses with the available personnel, which in some cases included substitute teachers and tutors who were hired *ad hoc* if teaching funds were available. Since student numbers also varied between universities and within universities between subjects, the teaching loads of Australian academics varied enormously. Academics in our sample reported between four and fifteen contact hours per week.

These teaching loads could be reduced by three measures. One, which played a significant role in only one university, was a decision of a university to reduce teaching loads for selected academics who were designated directors of centres or otherwise important researchers who were likely to increase the university's grant income. A second measure was sabbaticals: the relief from teaching and administration tasks for one semester every three years. The third measure, which was important in many fields, was the opportunity for academics to 'buy themselves out of teaching' by requesting funds for a substitute teacher in their grant applications. An application for three years of funding could include up to three semesters with teaching buy-outs.

Behavioural Expectations

All academics in standard university positions (teaching and research positions) were expected to conduct research even though the university did not provide the necessary resources. Universities also expected high-quality research. However, quality measurement amounted to little more than applying the measures used in the indicator-based funding schemes. Thus, academics were expected to win grants, to publish, and to supervise

[7] Australia lacks the knowledge-based industries that fund university research in other developed countries. Probably for the same reason, there was little additional government funding for applied research (for example, by the various ministries). For an extensive analysis and comparison of Australian and German funding landscapes see Laudel (2006).

Ph.D. students. Owing to the weight of the grant indicator, the emphasis lay on grants. The expectations to publish were often reduced to the four types of publications that counted in the funding scheme: books, book chapters, peer-reviewed journal articles, and full peer-reviewed conference contributions. These expectations were communicated in annual performance reviews each academic had to undergo. These reviews were largely inconsequential. More importantly, the indicators were also applied in decisions about promotions.

The external funding environment unequivocally communicated the need to conduct useful research. This expectation was directly built into one of the major grant schemes—the 'Linkage grants' which required co-funding by an industry partner—and more indirectly institutionalized in the 'Discovery grants' which had to demonstrate a 'national benefit'. Even though 'workarounds' concerning this criterion were accepted in some fields, the expectation was clear and all academics knew that demonstrating a national benefit could make all the difference between being funded or not being funded.

Authority Relations

Following Weber (1947), a tradition within organizational sociology (Scott 1992), and the conceptual approach provided by Whitley (Chapter 1), we define authority as legitimate power. The authority structure of Australia public science system fits Whitley's type of a state-delegated competitive system, which is characterized by a high authority of research funding agencies and national academic elites and a medium authority of all other authoritative agencies. The Australian government used its authority to establish an indicator-based funding scheme for the block funding of universities. The universities reproduced this scheme internally, which reinforced the state's authority because its performance indicators became ubiquitous and were used to evaluate the research performance of each academic within the university.

More importantly, the money distributed by the block funding scheme was so scarce that universities used it primarily as investments in the ability of units and academics to win external grants. The absence of recurrent research funding made external grants a necessary condition for the conduct of research, and the clearly communicated expectation that academics should win external grants was addressed even to those academics who did not need them.

The strong pressure to win external grants dramatically increased the authority of the agencies that decided about grants: namely, the funding councils, the academic elites, the government, and collaborators from outside academia who could serve as 'industry partners'. The funding councils were by far the most important sources of grants. They reported to the government, which influenced their policy and had the authority to overthrow funding council decisions concerning the funding of individual projects (an authority which they actually used). Within these limits set by the state's retention of authority concerning decisions on grants, the members of the funding councils' disciplinary panels decided on the distribution of most of the Australian grant money. This gave the national academic elites, from whose ranks panel members were recruited, an exceedingly strong position.

Since the grants with the highest success rate depended on financial contributions from industry partners, the latter's authority over the research in question was also high. They were *de facto* in a veto position concerning the content of the research to be undertaken. Thus, by emphasizing external funding in its relations to the university and by creating a situation in which block funding is scarce, the government made university research dependent on competitive grants, thereby giving the authoritative agencies involved in grant funding the opportunity to use their monopoly on research funding for realizing their interests concerning the content of university research.

This general picture is incomplete unless another authoritative agency is included: namely, the academics who decide on research goals and approaches. Any exercise of authority over research goals is directed at the researchers who actually formulate these goals. The researcher thus is an 'obligatory point of passage' for authority relationships. The relative authority of researchers *vis-à-vis* the state, funding agencies, the epistemic elite, universities, and industry partners varied across fields and performance levels. Four groups of scientists were less affected by the authority relations described above. A very small group of top performers received all grants they wanted because of their high performance. These academics were sought after by both universities and funding councils. Their authority was high because they could threaten their exit by migration to another country, and because they belonged to one of the authoritative agencies: the elite. A second group of academics did not need many resources for their research, which in turn meant that the authority of all actors involved in the grant distribution process was diminished. A third group was those whose research interests coincided with the interests of the authoritative agencies. The

actual authority of those academics might be low, and the authority of the external actors high. However, there was no need to exercise authority, because the 'right' decisions were made anyway. The fourth group was those with the lowest authority. Some academics in our sample conducted so little research that an exercise of authority concerning their goals (if they had any) was pointless.

These four groups represent two performance-dependent and two field-dependent variations. The highest and lowest performers were not susceptible to authority relations because the former's authority was high and the latter were of no interest to authoritative agencies. The authority of academics from fields with low resource dependency was relatively higher because the basis of external actors' authority—their control of resources—was of less importance to those academics. In our sample of disciplines, mathematicians, theoretical physicists, theoretical political scientists, political scientists relying on secondary (published) data, and some of the historians belonged to the group of academics with relatively high authority. Finally, in all disciplines except mathematics there were some academics whose interest in applied research coincided with that of the authoritative agencies, and whose 'felt authority' concerning their research goals was therefore high.

5. Adaptive Behaviour and its Effects

The situations described in the previous section triggered two kinds of adaptive behaviour, both of which had distinctive effects on the content of the produced knowledge. Academics responded to the accessibility of funding for their research and to the behavioural expectations by *adapting their research portfolios*—the set of (potential) research trails they could follow or were currently following. They also responded to the actual availability of funds and time for research by developing specific strategies for *coping with scarcity*. The two kinds of responses had different effects and can be analytically separated.

The Adaptation of Research Portfolios to Funding Conditions

The management of research portfolios included decisions

- to start specific research trails or projects because of opportunities provided by the environment;

- to abandon research trails, projects, or aspects of projects because of perceived constraints;
- to avoid (not to start) research trails or projects because of perceived constraints; and
- to change the directions of research trails or projects.

It must be noted that only very few researchers perceived themselves as actively managing a research portfolio, and that decisions about individual research trails were not usually made with a 'research portfolio' in mind. Furthermore, the adaptation of research portfolios varied between performance levels. We found most of the adaptive behaviour with the average performers in our sample (see above, note 4, for a short description of our procedure). Across all fields, the best academics started research trails or projects mainly out of personal interests. Funding opportunities were a motive for average rather than top researchers. Only very few of the top academics (all of them in the biosciences) abandoned research trails or projects because of a lack of funding, and avoided research they considered unlikely to attract funding. Abandoning research because of insufficient funding occurred mainly among the average performers.

Taking this modification into account, some patterns of field-specific responses can be identified. In biology, physics, and geology, and in a few cases in mathematics, average performers started research trails when funding opportunities arose. In political science, external stimuli (external demands, suggestions, or perceived opportunities) could also initiate new research trails. In history, these external stimuli were the only factor; funding opportunities did not play a role in the start of new research trails. The properties of newly started research trails did not show any clear pattern except for biology, where newly started research trails were more applied than the already existing ones.

In all disciplines, research trails or projects were abandoned due to lack of funding. Another reason for abandoning research, the lack of time, was more important than the lack of funding in mathematics and history, less important in political science and biology, and did not play a role at all in physics and mathematics. In four disciplines no pattern of abandonment of research was detectable. In biology, basic and non-mainstream research was abandoned, while abandonment in physics decelerated research and narrowed research portfolios.

Only biologists reported that they also avoided certain research trails because they considered them to be 'non-fundable' in Australia. Again, basic and non-mainstream research was characterized this way. Academics

from other fields did not describe situations in which they avoided otherwise possible research trails.

In all fields except political science, academics also changed the directions of the research trails they were currently pursuing. This occurred because they followed funding opportunities (biology, history), responded to funding constraints (physics, geology), and complied with expectations of the university (mathematics). Across all five disciplines, the changes in directions of existing research trails consisted in a stronger emphasis on applied aspects of the research. While the adaptation of research portfolios showed a consistent pattern—a move to applied research and to the mainstream—its actual occurrence and the reasons given varied between disciplines. While funding for research played a major role in all disciplines, time for research was the primary reason for abandoning research trails in mathematics and history, and a secondary one in biology and political science. Only biologists abandoned lines of research because of their perceived 'non-fundability', and political scientists did not change their research trails by emphasizing applied aspects. We will further explore these differences when discussing the effects of adaptive behaviour.

Coping with Scarcity

Scarcity of time or resources occurred for a variety of reasons. The most important reason for insufficient resources was that academics were not successful with their grant applications and were forced to conduct their research with little or no money to spend. But even those who were successful often faced scarcity because grants were arbitrarily reduced. Time constraints were due to the competing tasks in the university: high teaching loads or administrative tasks. Coping with scarcity included the following decisions:

- to use supervised student projects (Honours, Masters, and Ph.D. students) as the main way of conducting research;
- to 'job': that is, to perform research projects or services for paying clients in order to maintain the resource base for research;
- to reduce the empirical basis of the research by choosing fewer or less suitable research objects or methods, or by conducting fewer experiments or observations; and
- to 'retard' research, either by temporarily abandoning it due to time or resource constraints or by slowing it.

Table 10.2. Academics' coping with scarcity

	Biology	Physics	Geology	Maths	Political science	History
Use of student projects	X	X	X			
'Jobbing'	X	X	X			
Reduce empirical basis	X		X		X	X
'Retard' research	X	X	X	X		X

Again, the decisions listed above were not in all cases conscious responses to a perceived situation of scarcity. For example, none of our interviewees described a decision to base his or her research exclusively on research student supervision. However, constructing the responses as decisions seems justified because they are clearly discernible behavioural patterns that are an aggregate effect of decisions, such as not to start an independent research project or whether to supervise Ph.D. students.

As is the case with the adaptation of research portfolios, coping with scarcity was not distributed evenly across performance levels. The top performers in our sample felt little need for such coping. Nor did the worst performers, because they did not conduct much research at all. Thus, there were only very few cases of reducing the empirical basis of research among the top performers. None of the top performers relied on student projects or 'jobbed'. However, instances of 'retarding' research were found across all performance levels except for the top biologists. If we take into account these modifications by performance levels, clear discipline-specific patterns of coping with scarcity emerge, summarized in Table 10.2. In three disciplines—biology, physics, and geology—some academics compensated for a lack of funding by continuing their research predominantly or exclusively on the basis of student projects they supervised or co-supervised.[8] Several of the low-performing academics gave the clear impression in the interviews that they rationalized their supervision of student projects as pursuing a research trail, even though they did not have a consistent research interest or strategy and just presented as their research what the students wanted to do. Interestingly, the academics in mathematics, political science, and history did not rely on student projects for their research.

[8] This was also a common practice in German universities.

'Jobbing' occurred in the same disciplines as the use of student projects. We found only very few instances of this practice (one each in biology and physics and two in geology). The absence of 'jobbing' in mathematics, political science, and history is most likely due to the absence of a demand for routine services.

Academics in four disciplines (unhappily) reduced the empirical basis of their research. These practices took field-specific forms. In biology, fewer objects were investigated, fewer methods applied, or fewer experiments conducted. In geology, unsuitable but cheaper sites for fieldwork were chosen, fewer sites included or fewer observations conducted. Political scientists investigated fewer cases or conducted fewer interviews. Historians cut the archival work; they did not go to particular archives, or spent less time there. There was no reduction of the empirical basis of research in mathematics, because mathematics is not an empirical discipline. Less trivial is the absence of this practice among physicists, which hints at the possibility that physicists have less leeway in designing their empirical research because of its more theory-driven and deterministic nature. Finally, 'retarding' research was a ubiquitous practice.

Variations in Effects

Four distinct changes in the production of knowledge could be observed as the result of the adaptation of research portfolios and of coping with scarcity. These effects varied between disciplines and between performance levels, as Table 10.3 suggests. A first widespread trend is the deceleration of otherwise unchanged research due to either funding or time constraints. This trend occurred across all disciplines except for the high performers in

Table 10.3. Changes in the knowledge production of the six disciplines

	Biology	Physics	Geology	Maths	Political science	History
Deceleration	AL	HAL	HAL	AL	AL	HAL
Narrowing of individual research portfolios	AL	HAL	HAL	HAL	HAL	HAL
Move to more applied research	HAL	AL	(HAL)			(HAL)
Reduced validity and reliability of research	HAL		HAL		HAL	HAL

HAL = effect occurs at high, average, and low performance levels; AL = effect shows only for average to low performers; parentheses = effect is weak.

biology and mathematics. A second general effect that could be found in all fields except for high performers in biology is the gradual narrowing of individual research portfolios. We found a significant imbalance between research trails and projects that are abandoned, avoided, or 'retarded' due to funding or time constraints, and research that is started because of new opportunities. Even high performers who win grants to fund their research, or do not need them, feel forced to leave out parts of their research because of felt restrictions in time or funding. The 'jobbing' also contributes to the narrowing of research portfolios because it consumes time—the most scarce of all resources for research. Jobbing and the imbalance between abandoned and started research trails reduced the breadth of academics' research portfolios. It is difficult to assess the consequences of this trend at the macro-level of fields. However, if breadth and diversity are a source of innovations in science, the innovativeness of Australian research is likely to suffer from this trend.

Third, in four of the six disciplines the content of research also changed in that research overall became more applied. Academics chose research problems or objects for their research which were relevant for the solution of societal problems, or conducted collaborative projects with partners from industry. While a good deal of window-dressing was involved, we also identified enough substantial changes in research content to state that the increasingly applied character of research was not just a matter of rhetoric. The trend towards more applied research can be clearly observed in biology and to a lesser extent in physics, history, and geology. No such trend could be observed in political science or mathematics. Mathematicians who have moved to or included applied research do so as a service to others—in competition to their research agendas rather than as a substitute.

Finally, a fourth change in knowledge production resulted from a surprisingly clear trend across several disciplines. The reductions in empirical work that occurred as a response to insufficient funding make the results in the affected empirical disciplines (biology, geology, political science, and history) less valid or reliable.[9]

[9] It should be noted here that our respondents did not like this at all. To the contrary, most of them were quite annoyed about being forced to work below the standards of their scientific community. But left with the choice between doing no research and doing it substandard, they felt forced to choose the latter.

6. Field-Specific Factors Modifying the Impact of Authority Relations

'Proximate Factors'

How can these field-specific effects of governance be explained? Our analysis of the factors that produce field-specific responses to authority relations suggests that it is useful to distinguish between two kinds of field-specific factors according to the degree to which a factor can be actively shaped by authoritative agencies. Analytically, these varying degrees of 'social shaping' correspond to two levels of abstraction. At a first level, 'proximate causes' of field-specific effects can be identified. These are factors that are properties of research that emerge from the interaction of a field with the environments it draws on in its knowledge production. These environments include neighbouring fields, sources of research technology, and the wider societal environment. Owing to their hybrid nature, these factors are highly dynamic and depend on local and historical circumstances. At the same time, this hybrid nature makes them compatible with the institutional and resource environments of a researcher. The proximate factors are 'authority-sensitive' properties of research processes, which enable researchers to negotiate compromises between the requirements of research processes and the requirements and opportunities of institutional and resource environments.

At a second, higher level of abstraction relatively stable 'remote epistemic factors' can be identified. These factors are produced by the relatively stable epistemic practices of a field. They create opportunities and constraints for producing knowledge which, under the specific conditions provided by the field's environment, manifest themselves as the proximate authority-sensitive properties of research. We will discuss them in the following section.[10]

Figure 10.1 lists the 'proximate' field-specific factors, tentatively ranks disciplines according to the strength of the properties, and links the factors to changes in the knowledge production by stating how it sensitizes or

[10] It is important to note here the many contingencies that must be taken into account in such an analysis. The epistemic factors are not universal timeless properties of research. 'Proximate' epistemic properties of a field are contingent on the development of that field as well as other fields and the social organization of research. 'Remote' epistemic factors are at least contingent on the current developmental stage of a field. This means that the following considerations—especially those on 'proximate' epistemic factors—are specific to the social context for which they were obtained: namely, Australian university research. We are also aware of the fact that our analysis is based on interview responses that lack a cross-disciplinary yardstick. However, we consider our exploration of these factors as an entry in their systematic *empirical* investigation, which requires comparisons between countries and over time.

'Proximate' field-specific factors	*Tentative Ranking of disciplines according to the strength of the factor*	*Sensitizes research to*	*Desensitizes research to*
Resource dependency	Biology Physics Geology Political Science History Mathematics	Scarcity of resources Expectations tied to the provision of resources	
Diversity of individual research portfolios	Physics, Biology Geology History Political science Mathematics	[Narrow portfolios-one trail]: Scarcity of resources External expectations	[Diverse portfolios–more than one trail]: Scarcity of resources External expectations
Correspondence to societal problems	Biology Physics Political Science Geology History Mathematics	Expectations to conduct applied research	Scarcity of resources (access to more sources, 'jobbing')
Competitiveness	Biology Physics Mathematics Geology Political Science History	Scarcity of time and funding	
Dependency on uninterrupted research time	History Mathematics Political Science Geology Biology, Physics	Scarcity of time	

Figure 10.1. 'Proximate' epistemic factors and their role in the mediation of governance

desensitizes research to specific conditions created by authoritative agencies.[11] A first factor is the resource dependence of research, which refers to all material resources (including the salaries of researchers) that are required for the production of new knowledge in a field. Research can be *existentially dependent* on resources because it requires equipment and consumables. Much empirical research belongs to this category, in particular the experimental sciences but also large-scale empirical policy research and geological fieldwork. Other research processes were *strongly dependent* on resources because they could be conducted without resources only at the cost of

[11] The 'proximate' factors do not only vary between disciplines but also between fields within disciplines. For example, theoretical physics and political theory belong in the same category of resource dependency as mathematics, and the resource dependency of history and empirical political science varies internally. Thus, any of the rankings of disciplines should only be taken as a rough estimate that also depends on our sample.

breadth, validity and reliability, or timeliness of results. This level of dependence was observed in empirical non-experimental disciplines such as small-scale empirical political science, geological fieldwork, and most sub-fields of history. Finally, some fields are only *weakly dependent* on resources because their knowledge can be produced by using only the resources that are provided as basic infrastructure independently of any specific research process. Weakly resource dependent fields in our sample were pure mathematics, sub-fields of history that do not require archival work, and political theory.[12]

Naturally, higher resource dependence means higher sensitivity to scarcity and a higher responsiveness to expectations tied to the provision of resources. This is why in the existentially resource-dependent disciplines of physics and biology only high performers who receive all the resources they need did not feel constrained in their research. In weakly resource-dependent disciplines (mathematics and history) there were more academics who did not feel constrained, and those included high to average performers. The other academics had to apply for money and therefore were forced either to follow the signals of their funding environment, or to cut down their research.

The second factor we could identify is the *diversity of individual research portfolios*. The disciplines in our sample markedly varied in the numbers of distinct research trails pursued by an individual academic. Again, these findings depend on the performance levels of academics. The high to average performers in biology and experimental physics and the average performers in history simultaneously pursued several distinct lines of research, while political scientists, mathematicians, geologists, high performers in history, and low performers in biology and experimental physics had only one research trail.

The diversity of individual research portfolios affected academics' opportunities to start, abandon, or avoid research in order to circumvent scarcity or external expectations concerning their research. In particular, academics who had narrow research portfolios consisting of only one research trail could not abandon this trail without either giving up research at all or

[12] This does not mean that additional resources would not accelerate or improve research in weakly resource-dependent fields. More money can always improve working conditions: for example, by increasing research time through teaching-buy-outs, by providing the opportunity to buy books rather than waiting until a library has acquired them, or by funding more travel and better offices. The main difference between strong and weak dependence is the difference between the indispensability of resources for the conduct of research according to the standards of the scientific community and the possibility of using resources to produce these results faster.

radically changing it. Thus, the pressure to respond to funding problems by emphasizing applied aspects, reducing the empirical basis of the research, or relying on student projects, was much stronger for researchers with single-stranded research portfolios than for those with multi-stranded research portfolios. On the other hand, researchers with multi-stranded portfolios could more easily satisfy external expectations or respond to scarcity by abandoning one of their research trails or starting additional ones.

The *correspondence to societal problems* affects research mainly through the existence of external users for the research. These users affect the availability of resources, either by paying for research themselves or by providing academics with the opportunity to claim an applied character or 'national benefit' of their research. A correspondence to societal problems could be found in all fields, albeit to varying extents. It is often missing in pure mathematics, and not all fields of the other disciplines have equal opportunities to claim such a correspondence.

The correspondence of research to societal problems sensitized that research to external expectations to conduct applied research. If applied research is clearly possible, the expectations to conduct such research are likely to be more articulated. At the same time, the correspondence to societal problems desensitizes research to the scarcity of resources because it increases the number of sources that can be accessed, and in some cases enables the acquisition of resources by 'jobbing'.

The *competitiveness* of fields in terms of being first to find a specific result was a factor that was explicitly mentioned only in biology but has the potential to affect other fields as well. Our tentative ranking of fields in Table 10.3 is based on our findings but confirmed for some fields by the literature (on mathematics: Hagstrom 1965; Heintz 2000; on the biosciences: Latour and Woolgar 1986; Cambrosio and Keating 1995; Knorr-Cetina 1999). The competitiveness of a field sensitizes research to the scarcity of time and funding. Thus, the high competitiveness of biology made some biologists in our sample avoid specific research trails because they felt unable to compete under the Australian funding conditions. It also explains why the high performers in biology did not retard their research—they would abandon insufficiently funded research rather than conduct it at a slower pace. Historians, on the other hand, were not concerned at all about somebody else anticipating their work.

Finally, the disciplines in our sample varied according to their *dependency on uninterrupted research time*. This is a quite specific factor, because it does not refer to the absolute time available for research but to the necessity to

work on a problem without interruptions. This necessity was highest in history, closely followed by mathematics. Biology and physics appear to be far less dependent on uninterrupted research time. The collective nature of much of the research in these disciplines appears to correspond to the possibility for the lead investigators to make plans for others, to let them work, and to attend to the research process only occasionally and *ad hoc*.

Dependence on uninterrupted research time sensitizes research to the scarcity of time. If there is less time, it is very likely that there is also less uninterrupted time. This is why historians predominantly applied for external grants in order to buy themselves out of teaching. Time problems were given as reasons for a retardation of research and for reducing the empirical basis of research mainly in history and mathematics, and to a lesser degree in political science and geology.

'Remote Epistemic Factors'

The 'proximate' field-specific factors discussed in the previous section are obviously co-produced by the research practices of a field itself and the field's environment. For example, the resource dependence of a field is affected not only by the nature of the research but by the development of research technologies; the competitiveness of a field partly depends on the number of researchers financed in that field, and the dependence on uninterrupted research time partly depends on research technologies and the organizational design of research projects.

However, while the proximate field-specific factors depend partly on such environmental conditions, they also depend on inherent epistemic properties of fields; that is, on properties of the practices by which a field produces new knowledge. We call these properties 'remote epistemic factors' because they cannot be affected by authoritative agencies. The production of knowledge about a certain object requires actions that are specific to this particular object, which means that some of the properties of these actions cannot be changed without relinquishing the opportunity to obtain the knowledge.[13] In our investigation we inductively derived a tentative list of

[13] This does not mean that these properties are not subject to social influences. The nature of the knowledge produced by a field over time and the practices by which that knowledge is produced evolve, and they evolve in the human practices of knowledge production. For example, what is thought about in mathematics as 'proof' has changed quite dramatically over the last two centuries (Heintz 2000). However, these properties are 'hard' at any given time in that 'they cannot be wished away' (Berger and Luckmann 1967).

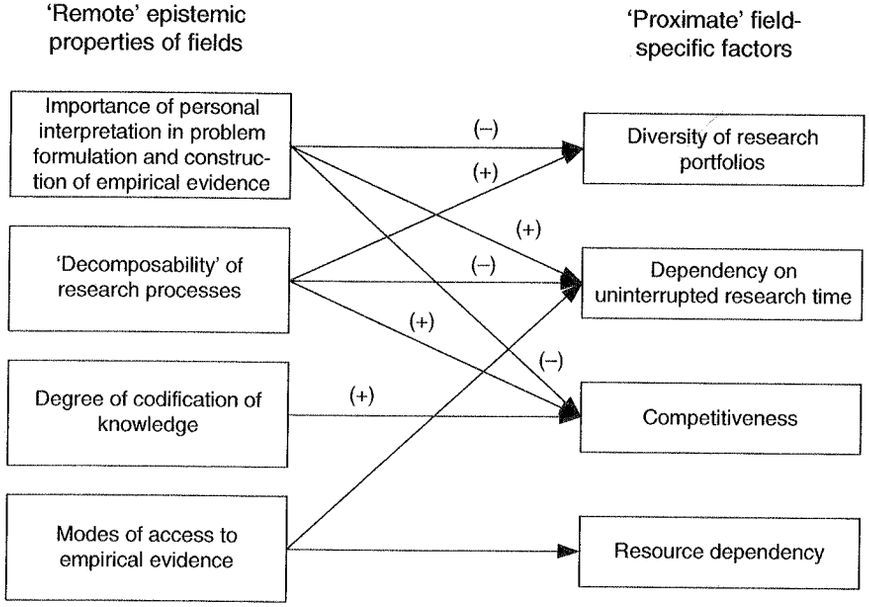

Figure 10.2. 'Remote' epistemic properties and their contribution to 'proximate' field-specific factors (the signs indicate a positive respectively negative influence of a stronger 'remote' epistemic property where strength is a relevant dimension)

some of these properties and their contribution to the authority-sensitive 'proximate factors' discussed above, as shown in Figure 10.2. This list is incomplete and awaits extension and modification in further research. The 'remote' epistemic properties are likely to interact with each other in ways that are not yet known. Some of them have been mentioned in the literature before.

Fields of research vary significantly in the extent to which problem formulation and construction of empirical evidence rely on the personal perspectives of researchers. In mathematics there is little room for personal interpretation since there is little disagreement about the truth of a mathematical statement. This is why sociologists of science have struggled with the unclear role of 'the social' in mathematics for decades—without having found a satisfying solution (Heintz 2000). At the other end of the spectrum, history (and other humanities as well) rely to a large extent on individual interpretation. In these fields, what constitutes empirical evidence to

support a claim, what a problem is, and how it should be addressed, depends on the perspectives of individual researchers.[14]

The *role of personal interpretation in problem formulation and construction of empirical evidence* affects the degree to which research tasks can be delegated to colleagues or assistants. Most historians who commented on the use of grants in history felt that there is no point in sending research assistants to the archives because they have to see the evidence for themselves. Furthermore, none of the interviewed historians considered Ph.D. students as a resource in their own research. Ph.D. students in history must find their own perspectives on problems, the literature, and evidence. They thus cannot contribute to the research of their supervisors. The same holds true to some extent for political theory.

The resulting necessity for the academics to do most of the research themselves sets limits to the diversity of research portfolios and produces great dependence on uninterrupted research time. It also limits the competitiveness of the field. It is entirely possible for two biographies of the same person to be published at the same time, and for both to be equally valuable contributions because they provide different perspectives.

The *degree of codification of knowledge*—the degree to which knowledge is represented by formal symbols with agreed-upon meanings—was first introduced as a property of fields by Zuckerman and Merton (1972; see also Cole 1983). It affects the competitiveness of fields because high degrees of codification limit the interpretive flexibility of the knowledge, which in turn increases the likelihood that researchers formulate similar problems and arrive at similar solutions to these problems. History and mathematics are again at opposite ends of the spectrum, with the codification lowest in history and highest in mathematics. It is possible that the degree of codification is the inverse of the role of interpretation. However, more research is needed in order to establish the co-variation of these two properties.

Another feature that is closely linked to the previous two but needs to be treated separately is the *'decomposability' of research processes*. We have already mentioned that this is low in history, where the low decomposability is due to the importance of personal interpretations, and noted some of the consequences. According to our interviews, the 'decomposability' of

[14] Which does not mean that 'anything goes' in the field of history. Personal perspectives are shaped in the interaction with other's research, and there are strong conventions about legitimate problems and fact constructions. However, these conventions only provide frames within which the individual historian decides about interesting and legitimate perspectives on historical processes as well as the suitability of empirical information to confirm or disprove a claim. See Lamont (2009: 79–87) on history as a consensual field with respect to methods.

research processes is also low in many fields of pure mathematics, although the reasons are likely to be different. Owing to their low 'decomposability', these fields are similar to history in the diversity of research portfolios, the separation of Ph.D. student supervision from the supervisor's research, and the sensitivity to time constraints. The similar consequences of different properties point to the need for further research to establish the relationships between the two. High 'decomposability' enables a division of labour in the research process and a delegation of tasks. Thus, additional resources can be used for hiring additional personnel and conducting more research under the direction of one group leader, which is a common practice in many fields of the biosciences. Obviously, this affects the resource dependence of fields.

A fourth property that plays a role as a 'remote epistemic cause' of authority-sensitive properties of research processes refers to the modes of access to empirical evidence. There is of course the obvious distinction between those disciplines which use empirical evidence in their knowledge production and those that do not. However, empirical evidence can be obtained in a variety of ways. It can be produced and thus be enhanced, or it can be inherently limited (for example, for ancient history). Furthermore, empirical evidence can be produced by observation or experiment. Experiments can be conducted as single events or as series providing data for statistical analysis. Observations can use more or less intrusive methods. This wide variety of modes of access to empirical evidence affects the resource dependence of fields. The extreme cases are fields of pure mathematics and high-energy physics. The former do not access empirical evidence at all, which contributes to their relatively low resource dependence, while high-energy physics accesses some of its empirical evidence by using supercolliders, which can only be funded by a collaborative effort of several countries.

This tentative list and discussion of relatively stable epistemic properties of fields that co-produce 'proximate' authority-sensitive properties indicates that it is possible and worthwhile to look beyond the immediate causes of adaptations. Since 'proximate' factors are co-produced by social contexts and epistemic properties of fields, they are difficult to compare across countries, organizations and time. Furthermore, the impact of changing authority relations in different disciplines is difficult to assess if disciplines are only compared in terms of their inevitably changing proximate epistemic properties. The identification of relatively stable epistemic properties of fields enables the construction of comparative frameworks that solve these problems.

7. Conclusions

In this chapter we have demonstrated that the exercise of authority had field-specific consequences for the production of knowledge. We have provided a tentative list of epistemic properties of fields that are responsible for the variation of effects between fields, and proposed mechanisms that produce field-specific governance instruments, field-specific authority relations, and field-specific effects of both. As a conclusion to this chapter we attempt a further generalization by asking how the exercise of authority by authoritative agencies other than the researcher changes the content of research.

The most general answer to this question is that authoritative agencies change the environment of researchers, who adapt their decisions about research to the changed situations. The translation of authority into changes in knowledge occurs at the individual and group level: namely, in the strategic decisions of academics about their research including the formulation of research problems, the selection of objects and methods, negotiations, collaborations, and the selection of communication channels. These decisions are partly made on specific occasions (for example, when project proposals are written or when experiments are designed). However, they are also woven into the everyday research activities of academics, and are often made implicitly (Knorr-Cetina 1981).

Like all actors, researchers make decisions in response to their perceptions of their situations. Authoritative agencies can change these situations by providing time or resources for research, increasing or decreasing a researcher's reputation in a specific social context, or formulating behavioural expectations. These elements of situations overlap with a researcher's epistemic room of manoeuvre, thereby creating opportunities to conduct research as well as constraints for that research. When academics make decisions about their research they must satisfy two conditions, both of which are necessary for continuing research. First, they need to design their research so that behavioural expectations are met to an extent that guarantees approval by their organizational and political environment. This approval is necessary for access to resources and to time for research, and possibly for achieving other goals such as promotion. Secondly, the research design must enable the production of a contribution that is accepted by the scientific community—a contribution that meets the community's expectations concerning relevance, originality, validity, and reliability. These expectations are tied to a field's specific research practices and epistemic properties. The latter produce

'technological' opportunities and constraints which are largely but not entirely the result of an historically contingent consensus of the scientific community.

The simultaneous adaptation of decisions to both authority-induced necessities and 'technological' necessities of the research process makes researchers respond to authority relations in a way that is specific to the field to which the research belongs. This is why field-specific effects are not only created by field-specific governance instruments or field-specific authority relations, but also by uniform governance instruments that are applied in different fields, or by uniform authority relations.[15]

Since all channels through which authority relations can influence scientific innovation go 'through' individual researchers and their decisions, where they are adjusted to epistemic conditions of research, these epistemic conditions modify the exercise of authority.[16] At the meso- and macro-levels, the extent of such modifications is reflected as a varying compatibility of epistemic conditions of research with interests of authoritative agencies, which makes some directions of research possible or easier to follow than others.

Our findings on the field-specific nature of (responses to) authority relations and their causes are explorative and preliminary in nature—not the least because, in the context of our investigation, identifying epistemic factors meant dealing with intervening variables in a research design that was aimed at identifying impacts of governance. Further empirical research and theoretical discussion are necessary in order to find the best way of constructing remote epistemic properties. The results of this study also enable conclusions concerning the methodology of studying field-specific effects of governance tools. We have demonstrated that a careful operationalization of research questions makes it possible for science studies to identify links between governance and changes in knowledge production of which researchers are not aware—to go beyond collecting researchers' *opinions* about the impact of governance on the content of research. Our study also shows that it is important to take research performance levels of interviewees into account. These performance levels are an important

[15] For example, the authority relationships in biology and physics were similar, but the effects on knowledge production still differed because of the different epistemic properties of the two fields.

[16] Examples of unmitigated exercises of authority over research in socialist countries demonstrate that attempts to 'override' epistemic conditions lead to situations where no knowledge is produced at all, which is exactly why there were relatively few such interventions (Gläser and Meske 1996).

intervening variable because they modify responses to governance and thus the effects of governance. Since the moderation of effects of governance by performance levels varies between fields, it is necessary to include both dimensions when the impact of governance on the content of research is investigated.

A third methodological contribution of our study is the identification of 'remote epistemic causes' of field-specific effects. These variables appear to enable the construction of a stable framework for the comparative analysis of fields and their responses to governance. It seems difficult to construct such frameworks from the 'proximate' factors because these factors are co-shaped by authority relations, which makes them a composite of both independent and dependent factors and altogether too fluid for comparative analyses.

Two more important methodological lessons need to be taken into account in further research. The discipline is far too large a unit for the analysis of specific consequences of governance. Field-specific effects and their 'remote epistemic causes' must be studied at the level of epistemically homogeneous knowledge production processes: that is, scientific specialties. Furthermore, our data show that even carefully prepared and conducted interviews are of limited use for investigating field-specific conditions and effects of governance. Owing to the inevitable time constraints of qualitative interviews, they cannot go deep enough to produce the necessary data. Ethnographic observations appear to be the only method that can provide these data.

Our results enable tentative generalizations with regard to the channels through which authority is exercised. First, the results strongly suggest that the 'governance by money'—creating scarcity and tying behavioural expectations to the resources that are made available—cannot be successful in all fields. It can be used to change the directions of research in existentially and in strongly resource-dependent fields, but is unsuitable for achieving aims related to all fields such as higher research quality. Secondly, in the fields where the 'governance by money' is most effective it is also likely to produce a strong unintended side effect: namely, a diminishing research quality of average researchers who cannot secure adequate resources for their research.

From our project it also follows that the frequent implicit assumption that a governance regime affects all fields in the same way (or affects some 'target fields' in the intended way and leaves the others unaffected) is likely to be wrong in most cases. Whenever governance instruments change the content of research by affecting the practices of knowledge production, it is very

likely that the enormous variation of research practices between fields causes variations in both the ways in which governance instruments are shaped within fields and the actual outcomes of governance. This is why science policy studies must address the problem of 'implicit uniform models of science' that inform policy decisions, and must systematically discuss field-specific consequences of authority relations.

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11

Public Science Systems, Higher Education, and the Trajectory of Academic Disciplines

Business Studies in the United States and Europe

Lars Engwall, Matthias Kipping, and Behlül Üsdiken

1. Introduction

The twentieth century has seen a strong growth in higher education and public research organizations worldwide. Within this development there has been a successive addition of new disciplines to systems of higher education and research. What once were primarily institutions for theology have with the passage of time developed into organizations teaching and researching in a large number of disciplines. The inclusion of these new disciplines has had, and continues to have, an important influence on the production of new scientific knowledge and its dissemination, since academic status confers legitimacy and access to human and financial resources. And it confers this legitimacy not only on those admitted into academia, who thereby can have the opportunity to join the scientific elites, nationally and, possibly, internationally; it also confers an increased status on those graduating from these academic institutions, helping them gain entry into national elites—depending on the status of the discipline and the educational institution.

Yet, this development has not been without conflicts regarding the appropriateness of new fields of study and research. Those inside higher education institutions are often reluctant to grant academic status to new disciplines, since this means increased competition for students and

Reconfiguring Knowledge Production

Changing Authority Relationships in the Sciences and their Consequences for Intellectual Innovation

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and
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Preface

This book developed from discussions in 2006 between Sigrid Quack, then Chair of the European Group for Organization Studies (EGOS), Richard Whitley, and Lars Engwall about how the changing governance of the public sciences in many countries was affecting the direction of organization studies. These led to the forming of a subtheme group on 'The Changing Organisation of the Sciences and the Changing Sciences of Organisation' at the 2008 EGOS Colloquium in Amsterdam. It generated enough interrelated papers to form the basis of a coherent volume about the effects of the restructuring of public science systems on the authority relationships governing research activities and, consequentially, on intellectual innovations in different scientific fields. Revised versions of these contributions, together with a few new invited papers were discussed at a workshop held at the Royal Swedish Academy of Letters, History and Antiquities in Stockholm in February 2009. We are most grateful to the Academy for its support and assistance in hosting this workshop. We are also indebted to the Bank of Sweden Tercentenary Foundation for financial support for this event. Finally, we want to thank all the participants at the two meetings for their contributions to our discussions, and to the authors of the chapters in this book for responding so effectively to our editorial suggestions.

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