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21. How can governance change research content? Linking science policy studies to the sociology of science

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INTRODUCTION

Although science studies routinely assume that governance can change research content, we know little about *how* it does that. Science policy actors, commercial interests and civil society actors utilise a variety of governance instruments and processes to change the directions or to improve the quality of research. Both can be achieved only by making researchers select different goals and approaches, that is, change the content of their work.

A recent review returned very few studies that investigated the impact of governance on research content and even fewer that convincingly established causality (Gläser and Laudel 2016). Empirical studies of competitive project funding focused on the validity and reliability of selection procedures and largely shunned the investigation of pre-emptive adaptation of project content or effects of selective funding on the dynamics of research fields (ibid: 122–125). The governance of emerging fields has been studied with the fields' growth as the only dependent variable approximating content (ibid: 126–129). Most studies of the effects of performance-based funding limit themselves to changes in publication behaviour, whose causal ascription to performance-based funding can charitably be described as tenuous (ibid: 129–134; Gläser 2017). Finally, studies of academy–industry links have produced some interesting results on the impact of such links on the diffusion of knowledge (Evans 2010a; b) and on the increased likelihood of findings that are consistent with an industrial funder's interests (Krimsky 2013) and on the impact of such links on the diffusion of knowledge (Evans 2010a; b). However, the empirical evidence of many studies is contradictory, which has led to a call for more in-depth studies of academy–industry links (Krimsky 2013).

Most of these findings do not lend themselves to theoretical generalisation because they draw on specific cases in particular fields. More importantly, theoretical progress cannot be achieved with the current implicit division of labour between subfields of science studies. Science policy

studies investigate governance arrangements and processes, while the sociology of science focuses on the construction of scientific knowledge. Calls for an inclusion of the ‘performance level of the science system’ in science policy studies (Mayntz and Schimank 1998: 753) and for the consideration of institutions in laboratory studies (Knorr-Cetina 1995: 160–163; Kleinman 1998: 285–291; Mayntz and Schimank 1998: 751) remained unheeded for a long time. The ‘new political sociology of science’ (Frickel and Moore 2006) attempts to bridge the two approaches and to establish causality (ibid: 8–9). However, so far it has merely demonstrated how difficult it is to treat policies and knowledge production at the same level of detail in one study. This points to an asymmetry that further hinders the integration of studies of governance and of research content: the former are usually conducted at the macro-level that corresponds to the scope of governance instruments, while the latter prefer the micro-level. Neither field systematically investigates aggregate effects of micro-level processes of knowledge construction. They are sometimes addressed by bibliometrics, which tries to reconstruct meso- and macro-level knowledge structures from publication properties but does not link its approaches or findings to those of other fields. Ultimately, the question about impacts of governance on research content disappears in the cracks between fields contributing to science studies.

The aim of this chapter is to bridge these gaps by asking how – by what mechanisms and with what effects – research content can be intentionally influenced, and which means of changing research content are available to which actors. I argue that the many governance instruments developed and utilised by actors interested in changing research content have to employ a combination of very few mechanisms for exercising influence. A systematic consideration of these mechanisms and ways in which researchers can respond to their resulting decision situations makes it possible to understand how, and under which circumstances, governance can change research content.

My discussion focuses on intentional change and does not consider any secondary (unforeseen or unintended) effects such as, for example, the disappearance of research topics due to quasi-market failures of performance-based research funding systems (Gläser 2007; Laudel and Weyer 2014) or changes in research content that are secondary effects of changes in teaching. Even within these limits, the argument is quite complex and cannot be fully developed in the confines of this chapter. The second section specifies the explanatory task by demonstrating that researchers are ‘obligatory passage points’ for influences on research content. The third section uses a sociological perspective on influence to establish the general ‘toolkit’ available to actors for exercising influence on

others. The fourth section outlines how these instruments can be applied to change research content. The fifth section identifies possible responses by researchers. My conclusions regard the room for manoeuvre for the governance of research content as well as consequences for the design of governance.

RESEARCHERS AS OBLIGATORY PASSAGE POINTS IN THE GOVERNANCE OF RESEARCH CONTENT

Governance can be defined as the construction and exercise of authority in constellations of interdependent actors (Rosenau 2004: 32; Crouch 2005: 106–125). In this chapter, I consider the governance of research content, which can be specified as the construction and exercise of authority over research goals and approaches (Gläser 2010; Whitley 2010; 2011). Not surprisingly, this governance is a multi-level system that includes micro-level, meso-level and macro-level actors. However, science differs from other societal subsystems in the prominent role of the micro-level of individual researchers, which is directly linked to all other levels. System-level organisations like research councils and governance instruments like funding programmes often involve individual researchers directly. Individual researchers and research groups appear to be the immediate focus of most instruments in the governance of science.

The reason for this special position of researchers in the governance of research content is their monopoly on decisions on that content. In one of the first laboratory studies, Knorr-Cetina (1981) observed that the everyday laboratory work of researchers is impregnated with decisions on methods, the use of equipment, materials, collaborations, and other elements of the production of new knowledge. These decisions shape the conduct of research and, consequently, the content of the knowledge that is produced. Some decisions are made with explicit consideration of the consequences for the content of knowledge production, while others are made ad hoc, in order to ‘make experiments work’, without systematically considering all the consequences for later results.

Knorr-Cetina’s account of researchers’ decision-making has been implicitly confirmed by other studies (e.g. Lynch 1985; Latour and Woolgar 1986 [1979]; Fujimura 1987). From these observations of ethnographers of knowledge production follows that all decisions that immediately influence research content are made by the researchers themselves. Among these decisions are not only the everyday decisions on experimental set-ups, data collection, or data interpretation but also decisions about research goals and approaches, which affect directions of research in the

longer term. With the latter decisions, researchers themselves define their tasks and approaches to solving them.

The reasons for this self-assignment of tasks, which is quite unusual in collective work processes, have been discussed by Benkler (2002). In his analysis of web-based knowledge production, Benkler observed that 'individuals self-identify for tasks' (ibid: 376). He argued that the self-identification of tasks and producers increases the likelihood that producers have tasks they are actually able to solve, a match which would be very difficult to achieve otherwise because another actor is rarely able to adequately assess the creative abilities of a producer (ibid: 414–415). Thus, only researchers themselves can define goal/approach combinations that they are likely to employ successfully.

The self-identification of researchers for tasks is ordered by the knowledge with which they work. Members of a scientific community adjust their actions to each other through observation and unilateral action. They observe their community's body of knowledge, derive problems and approaches to solving them from their interpretation of that knowledge, and offer contributions to the further development of the community's knowledge in publications. Their common referent – the shared knowledge – increases the likelihood that independent self-identifications lead to contributions that fit and thus can enhance the existing knowledge.

Observation and unilateral self-identification do not produce perfect adjustment. However, the inevitable deviations between interpretations of the shared knowledge also have a productive function. In many situations of communal knowledge production the following points may be unknown:

- what exactly the problem is that needs solving (how it should be formulated);
- whether there is a solution to the problem at the current stage of knowledge;
- how the problem could be solved;
- what knowledge can be regarded as valid and reliable and should therefore be used for solving the problem;
- who can solve the problem.

In these situations decentralised autonomous decision-making is efficient because it means that many independent attempts to formulate and solve problems are undertaken simultaneously. While some (and sometimes most) of the attempts are bound to fail or to become redundant, the decentralised approach provides the highest likelihood that the problem is solved as quickly as possible (Gläser 2006; 2007: 247–248). Self-identification is

thus the joint product of both individual-level functional requirements – researchers are in the best position to formulate tasks they can solve – and community-level functional requirements – independent task formulation increases the likelihood of successful knowledge production under extreme uncertainty.

An important consequence of the self-identification mechanism is that all influences on the content of knowledge are mediated by a researcher's decisions. In the language of actor-network theory we can describe the researcher as an 'obligatory passage point' (Callon 1986: 205–206; Latour 1988: 43–44) for influences on the content of research because only researchers' decisions can translate these influences into changed research content. Actors who are not researchers but intend to change research content can either move these 'obligatory passage points' around (acquire them, remove them, recombine them), or they can attempt to influence their decisions. Bypassing them is impossible.

THE 'TOOLKIT' FOR INFLUENCING ACTORS

Exercising influence on researchers to produce particular knowledge is a specific case of the central sociological idea of Ego changing Alter's behaviour. Taking up Parsons' (1963) critique of the 'conceptual diffuseness' surrounding the concept of power, I follow Schimank and use 'influence' as the overarching concept (Schimank 2010; Gläser and Schimank 2014). This move makes it possible to reserve the concept of 'power' for the narrower phenomenon of achieving behavioural change by coercion based on (the threat of) physical force. The exercise of influence over an actor can be defined as the implementation of a behavioural expectation, if necessary against the interests of the expectation's addressee.

In order to arrive at a set of influences on an actor's behaviour that is exhaustive, I consider two distinctions between possible targets for influences.¹ A first distinction is between an actor's ability to behave in a certain way and their wish to do so. The second distinction is between a modification of the situation to which the actor responds and the modification of an actor's interpretation of their situation, that is, their frames, beliefs or interests. Based on these distinctions, four ideal-typical basic modes of influencing actors can be distinguished, namely three that change the situation and one that changes its interpretation. First, Ego can force Alter to carry out a particular action or suppress Alter's actions by *coercion*. Coercion changes Alter's situation by threatening physical force. Second, Ego may enable, facilitate, hinder or make impossible actions by providing or withholding the necessary means for carrying out

Table 21.1   *Modes and forms of exercising influence*

		Modes of influence			
		Coercion	Equipping	Inducement	Suggesting re-interpretation
Forms of influence	Interactive	Command	Allocation	Reward	Transmission of specific information
	Mediated by structures	Prescriptive rules	Institutionalised allocation procedures	Institutionalised reward procedures	Institutionalised belief systems

an action. This mode of exercising influence by (*not*) *equipping* Alter also changes Alter’s situation. Third, Ego may make Alter’s actions more or less attractive by providing positive or negative rewards (*inducement*). The presence of positive or negative rewards also changes Alter’s situation, this time with the intention to make Alter change their goals. Fourth, Ego may change Alter’s interpretation of the situation and goals by *suggesting a re-interpretation of the situation*, which can be achieved by providing specific information or references to values. This includes the withholding of information or references to values to make Alter pursue particular goals.

These four modes of exercising influence can be applied in two different social forms, namely interactively and structurally mediated (Table 21.1).² The interactive exercise of influence occurs through issuing commands, allocating or withdrawing resources, providing or withholding rewards, or transmitting specific information. The structurally mediated exercise of influence involves prescriptive rules, institutionalised resource allocation procedures or reward procedures, or institutionalised belief systems.

These modes and forms are ideal types. Empirically, we can expect hybrids of the modes or forms.

THE TOOLKIT APPLIED IN THE GOVERNANCE OF RESEARCH

We now turn to the ways in which these generic ‘tools’ of exercising influence can be used to influence researchers by asking which tools are available to whom and under what circumstances. Since exercising influence requires an actor, researchers’ scientific communities must be excluded from these considerations. Scientific communities are identity-based constellations of actors whose members perceive each other and

themselves as working with the same knowledge, and adjust their actions to that knowledge. Since community members act independently of each other, scientific communities lack the ability to formulate common goals, to collectively mobilise resources for goal attainment, or to make decisions that bind their members. Therefore, they cannot be considered as collective actors. The knowledge and preferences to which researchers adjust are *emergent effects* of a multitude of unilateral actions of and interactions between community members rather than effects of an actor's exercise of influence. However, community members (a researcher's peers) do exercise influence by participating in decision processes.

A second important social context from which influences on research emerge is the organisation researchers work in. Research organisations include publicly or privately funded universities or research institutes as well as private organisations such as commercial enterprises or non-governmental organisations (NGOs) featuring research departments. They provide paid positions for researchers, channel resources to them and communicate societal expectations. In addition, they enable interactions with markets for equipment, materials and publications. Research organisations thus provide interfaces for influences of societal actors on researchers. They also develop their own interests as corporate actors, and may attempt to influence researchers accordingly.

Other relevant actors include the state and its organisations, commercial enterprises, civil society organisations representing social movements or other interest groups, and individuals who develop interests concerning research content and can exercise influence on research content. The modes and forms of influence accessible to them vary depending on their position in the system of governance.

Coercing Researchers

Coercing researchers means to command them (not) to conduct specific research or to design rules that force or suppress such research. This mode is the only one that replaces the decisions of researchers and thus their self-identification mechanism. An actor's capability to coerce researchers depends on the opportunity to command them, the ability to define research that is to be forced or suppressed, and the ability to monitor compliance. The opportunity to command depends on super-ordination in a hierarchy that legitimises commands and the threat of physical force by superiors (which in most cases amounts to the physical removal of an employee from the organisation's premises). This is a common situation in organisations. The ability to force research requires knowledge that is quite similar to that of the researcher who is to be commanded.

Formulating research problems and selecting approaches is based on the interpretation of the scientific community’s knowledge, standards and preferences, of the opportunities provided by the local work environment, and of the researcher’s own knowledge and abilities. Actors who want to force specific research need that knowledge to formulate problems and monitor compliance. Suppressing research largely depends on an actor’s ability to monitor compliance, which requires less intimate knowledge of the research. This difference in knowledge requirements creates a fundamental asymmetry in the exercise of coercion. It is easier – and thus possible for a larger number of actors – to suppress specific research than to enforce it.

Since coercion inevitably includes references to the community’s knowledge, all attempts to coerce are hybrids between coercion and suggesting a re-interpretation of the situation. In most cases, suggesting re-interpretation is likely to be the ‘frontstage’ mode, with coercion acting as a ‘backstage’ threat. Furthermore, forcing research is possible only in situations in which a researcher’s peers – members of the same scientific community – are superordinate in a hierarchical relationship (Table 21.2). However, members of scientific communities know about the importance of self-identification for successful research and tend to follow the norms of non-intervention that guarantee it. This is why even in the institutes

Table 21.2   Tools for exercising influence on researchers through coercion

Actors	Forms of coercion	
	Interactive	Structurally mediated
Research organisations	Forcing research through superordinate peers in organisational hierarchies Suppression of research through organisational hierarchies	Suppression of research through contractual arrangements (e.g. licensing agreements) Suppression of contributions through contractual arrangements
State Funding agencies	None	Regulation of research through law (safety and ethical standards) Suppression of contributions through contractual arrangements
Commercial enterprises Other actors	None	Suppression of contributions through contractual arrangements

of the Academy of Sciences of the German Democratic Republic, that is, under conditions of strong double hierarchies of the state and the communist party, direct interventions into decisions on research were rare events. Researchers occupying positions in the state hierarchy knew about the functional necessity of self-identification. Other powerful actors lacked the knowledge required for a meaningful coercion (Gläser and Meske 1996; Mayntz 1998).

Coercion between members of a scientific community can occur only with the backing of formal organisations. In research organisations, the enforcement or suppression of research questions may occur in supervision relationships. The most common of these is PhD supervision. Most PhD students do not yet conduct independent research (Laudel and Gläser 2008), which in many fields in the sciences and engineering includes that they do not formulate their own research questions (Laudel 2001: 766). Instead, students might be assigned tasks for their PhD projects or are at least required to negotiate their research problem and approach with their supervisors (which is common in the social sciences and humanities). A far less common situation is the supervisor–researcher relationship in research organisations, when researchers from the same community who rank higher in the organisational hierarchy force researchers to address specific problems. This is also likely to occur in industrial research (Fujimura 1987), but we know very little about these research processes (Penders et al. 2009). They may also exist in other organisations hosting research, about which we know even less. A general restriction to this form of coercion is that supervisors will always have a limited understanding of their subordinates' problem-solving capabilities.

The state and other actors who do not employ researchers directly do not have the opportunity to coerce them because there is no direct hierarchical subordination of researchers.

In addition to these interactive forms of coercion, which are based on formal structures but use commands, there are only few structurally mediated forms. These include the suppression of research through ethical and safety regulations by the state and funding organisations (on the regulation of research on human stem cells in France see e.g. Brunet and Dubois 2012) and the suppression of contributions through non-disclosure agreements between researchers and their clients (for industry clients see e.g. Krinsky 2013). These structures define behaviour that can be monitored by outsiders. However, as licence agreements with researchers demonstrate, as soon as compliance becomes difficult to monitor or is subject to scientific interpretation, structurally mediated coercion fails (Eisenberg 2001).

(Not) Equipping Researchers

Researchers can be influenced by (*not*) *equipping* them with resources that enable specific research. Resources include knowledge, instruments, materials, infrastructure and money. These resources vary in their genericity, that is, in the extent to which they support all research or only specific research content. Knowledge, equipment and materials are specific in that they support some directions of research but not others. Infrastructure can be generic or specific. Providing researchers with knowledge and specific materials or equipment is a hybrid form of influence because it also suggests a re-interpretation of the situation. Money is a generic resource but can be made specific by providing it for specific purposes.

Influencing researchers by equipping them requires ownership of resources, which differs considerably between actors (Table 21.3). A researcher's peers are in the best position to exercise influence by equipping colleagues with knowledge and materials because they work with the same knowledge and on similar problems. Community members are also involved in decisions on research funding and opportunities to publish through peer reviews.

External actors can also influence research content by equipping researchers with knowledge or material resources. Anyone who equips researchers with specific information or tools can use this process to influence them because new information or tools enable different actions

Table 21.3   Tools for exercising influence on researchers through (not) equipping them

Actors	Forms of equipping	
	Interactive	Structurally mediated
Peers	Communicating knowledge, providing materials Peer review in funding and publication decisions	Contributing to the community's body of knowledge Participation in the implementation of competitions for research funding
State	Providing access to research objects, equipment or data	Implementing competitions for research funding
Funding agencies		
Research organisations	Funding specific research (positions and resources)	
Commercial enterprises		
NGOs		
Other actors		

and cause researchers to re-interpret their situation. For example, the German state governments barred education researchers from schools for a long time. Schools were made accessible for data collection only after the federal states became interested in Germany's participation in educational attainment studies (Gläser et al. 2014: 283–284). Similarly, knowledge produced by industrial research can be made available to scientific communities to build on (Grieser 2018). Rare disease patient groups have begun 'using their collective lay experiences, knowledge about living with various diseases, as a unique, legitimate, and valuable source of research data' (Polich 2011: 167; see also Brown et al. 2006: 525; Panofsky 2011: 38, but see Moynihan and Bero 2017 on the influence of pharmaceutical companies on many patient groups). The effects of this form of exercising authority are often difficult to predict because researchers combine the knowledge provided by an external actor with the community's knowledge and the knowledge they have accumulated in prior research.

The most important way in which external actors influence research is funding, that is, the provision of paid positions for researchers in organisations or equipping researchers with money. In these cases, research content is influenced by tying the provision of resources to specific expectations concerning its content. This mode of influence is used for a wide range of interests, with expectations concerning research topics being the most common. Government funding is often tied to expectations of societal usefulness. Recent and current examples include research on nanotechnology (which is expected to contribute to industrial innovations, e.g. Johnson 2004), renewable energy technologies (preventing climate change, e.g. Dalpé and Anderson 1995) and health research (cures for diseases, e.g. Cooksey 2006). Expectations of usefulness can also be framed as a general demand across all fields (Pavitt 2001).

Other expectations concern the way in which research is conducted (Braun 1998: 810). A prominent current example is interdisciplinarity, which in some cases is funded without any further specification of content or approaches because it is regarded as leading to intellectual innovations and often as contributing to the solution of societal problems (Weingart 2000). External actors can also make funding conditional on certain standards being met by the research or certain approaches not being used. Examples include the 2001 decision by the US government to prohibit federal funding for the development of and research on new human embryonic stem cell lines (Furman et al. 2012) and funding programmes for the development of alternatives to animal experimentation (Liebsch et al. 2011: 848–849).

Public and private research organisations tie expectations to the allocation of their resources for research in similar ways. A prime example is the

definition and filling of positions for researchers, which is based on more or less specific expectations concerning the content of the research to be conducted. This expectation-based equipping of research has increased in many countries where universities attempt to build distinct research profiles (Meier and Schimank 2010; Laudel and Weyer 2014).

Finally, contract research is an important way of exercising authority through equipping research. This form is often used by commercial enterprises that require specific knowledge for their innovation and production processes. The contractual relationship is negotiated but creates a basis for coercion once it is agreed (see the discussion of coercion above).

The structurally mediated exercise of influence by (not) equipping researchers occurs through two kinds of structures. First, community members can attempt to influence their peers by changing the community's body of knowledge with their publications. This influence is likely to be weak in most cases because each publication added is just one of many. Second, all actors have the opportunity to exercise influence through the institutionalisation of competitions for funding in which the applicant's response to expectations concerning content is a selection criterion.

The mechanisms of (not) equipping researchers can be used ubiquitously because they leave the basic mechanism of self-identification for tasks intact and because all research depends on material resources in some ways. The central problem of this mode is how to monitor compliance with funders' expectations. This problem is the focus of principal-agent theory, which has been applied to the analysis of funding councils (Braun and Guston 2003). Since assessing the fit of proposals with expectations and monitoring compliance require scientific knowledge, peer review is an essential feature of project-based funding and recruitment processes (Van den Daele et al. 1977; Braun 1998). In the case of contractual research, funders usually have their own research capacity, which means that peers can monitor the funded research.

The dependence of research funding on peer reviews makes it possible to introduce preferences and standards of scientific communities as selection criteria for research funding, thus granting community members some control over other actors' resources. In contrast, external actors can formulate specific demands only with regard to secondary indicators of research quality such as numbers of publications – for example, for academics to publish 2.3 peer-reviewed journal articles each year. Although these demands are fictional because the relationship between the indicator and the aspect of research that actors want to influence (in this case, performance) is not clear, they may have consequences. The formulation of expectations concerning research by external actors appears to be con-

strained by a specific ‘uncertainty principle’: the closer expectations are to the research content, the less precisely can they be formulated.

Inducing Researchers

Researchers can be induced to produce particular knowledge or to refrain from doing so by granting or withholding rewards which make a particular research process more or less attractive to researchers. The capability to exercise this kind of influence depends on the opportunity to provide material rewards or social recognition.

Although the most important reward for many researchers is the social recognition they accrue in their scientific community, this is an emergent effect rather than an intentional exercise of influence with the aim to bring about particular research. Receiving recognition is a diffuse collective process that lets researchers accrue a relatively stable reputation from individual acts of recognition. The ‘baseline’ of this process is recognising researchers who offer contributions to their community’s knowledge as community members, that is, as fellow researchers, by using their work. This reward is important because having an identity as a researcher depends on being recognised by the community as contributing knowledge. However, it is not granted or withheld with the intention of making colleagues conduct specific research, and is thus not an exercise of influence. Scientific communities do not induce researchers. The reward procedures institutionalised by professional organisations of scientific communities do not induce researchers to conduct specific research, either.

External actors can induce the production of specific knowledge through financial rewards and social recognition (Table 21.4). The state can reward specific research financially and through social recognition. In research organisations, rewards take the form of salary increases and promotions. The reduction of teaching loads for particularly research active academics at universities is often perceived as inducement because, research being the preferred activity for many university academics, it is used as a reward for high research performance.

Other actors can use the same tools to induce the production of specific knowledge. Building social relations with researchers has been reported as one way in which social movements and patient organisations can influence researchers to deviate from the mainstream and turn to neglected problems (Brown et al. 2006; Panofsky 2011). These practices constitute hybrids of inducement (through social recognition) and suggesting a re-interpretation of the researcher’s situation (through reference to values).

Institutionalised arrangements of inducement include competitions between scientific or technical solutions in scientific communities (see

Table 21.4   Tools for exercising influence on researchers through inducement

Actors	Forms of inducement	
	Interactive	Structurally mediated
State	Financial rewards Social recognition	Markets for knowledge (IPRs) and innovations (spin-offs) Institutionalising performance-based pay systems
Research organisations	Promotion Salary increases Granting research time Social recognition	Institutionalising performance-based pay systems
Commercial enterprises	Financial rewards Social recognition	Markets for knowledge (IPRs) and innovations (spin-offs)
Funding agencies		Prizes
NGOs		None
Other actors		

McClellan III 1985, 11–12, 298 for early instances; Meister 2012 on the RoboCup as a contemporary case), performance-based salary schemes, and the markets which provide financial rewards in forms of royalties for patented knowledge and for knowledge turned into innovations (e.g. through university spin-offs, D’Este and Perkmann 2011). Performance-based salary schemes can be institutionalised at the state level (see Cruz-Castro and Sanz-Menéndez 2007 for Spain) or at the university level (see Kim and Bak 2015 for a South Korean university), although the latter are mostly realised interactively (see e.g. Gläser and Laudel 2007 and Gläser et al. 2010 for Australia; Biester and Flink 2015 for Germany).

Suggesting a Re-interpretation of Their Situation to Researchers

Research content may be influenced by making researchers re-interpret their situation and develop different research goals or approaches. This can be achieved through the provision of information or through references to values (Table 21.5). The provision of scientific information has already been described as a hybrid process of ‘equipping’ researchers with knowledge and simultaneously initiating a re-interpretation of their scientific situation.

Beyond these hybrid processes involving knowledge, researchers can influence their peers through the communication of values. Values of scientific communities support the adherence to standards of conduct and

Table 21.5 Tools for exercising influence on researchers through suggesting a re-interpretation of their situation

Actors	Forms of Inducement	
	Interactive	Structurally mediated
Peers	Communicating knowledge (hybrid with equipping) Communicating values	Contributing to the community's body of knowledge (hybrid with equipping) Modifying the community's values
State	Providing knowledge (hybrid with equipping)	Constructing ideologies/
Research organisations	Communicating values	systems of values
Commercial enterprises		
NGOs		
Other actors		

make researchers aware of priorities in problem solving. External actors may refer researchers to values, too. For example, describing the fate of patients with rare diseases and pointing out that nobody is looking for a cure might make medical researchers want to develop a cure for such a disease (Panofsky 2011).

The suggestion of re-interpretation also operates as structurally mediated influence through systems of knowledge, norms and ideology. Members of a scientific community may change its body of knowledge by publications, or may attempt to change its values in public discussions. External actors can produce ideologies as structures through which references to values are mediated. For example, a major societal discourse aiming at such a re-interpretation concerns the obligation of research to contribute to the solution of societal problems. Another current example, 'responsible research and innovation', is discussed by Owen and Pansera in Chapter 2 of this volume. Researchers are subjected to these discourses as well as other discourses legitimising or delegitimising certain kinds of research, for example lobbying by animal rights groups against research based on experimentation with animals (Enserink 2008).

Epistemic Conditions of Action Modifying Authority Relations

The modes of influence accessible to actors and the ways in which they can be used depend on the researcher's epistemic conditions of action, that is, on the properties of knowledge, material objects and instruments used in

the production of new knowledge. Despite their importance – they modify most causal relationships in which science studies are interested – they are still poorly understood (Laudel and Gläser 2014; Gläser and Laudel 2015). Conceptual suggestions by Whitley (1984) and Knorr-Cetina (1999) have never been operationalised, that is, linked to protocols for the empirical identification of epistemic conditions.

In addition to epistemic conditions of action suggested in the literature, some have been empirically observed in analyses of performance-based funding mechanisms (Gläser et al. 2010), the development of scientific innovations (Whitley 2014; Gläser and Laudel 2015; Whitley et al. 2018), and effects of funding schemes and prizes (Laudel and Gläser 2014; Franssen et al. 2018). From these investigations, hypotheses about the mediating effects of epistemic properties on the exercise of authority (Figure 21.1) and possible responses by researchers (see section ‘Responses by Researchers’ below) can be derived (see also Whitley, Chapter 11 in this volume).

The role of personal interpretation in problem formulation and construction of empirical evidence describes the extent to which the formulation

Figure 21.1 Modification of exercise of authority by epistemic properties

of problems and the construction of empirical evidence are guided by the community's knowledge and standards versus the researcher's ideas. It is high in the humanities, whose knowledge production relies on the constant introduction of new personal perspectives in the interpretation of research objects, and lower in the sciences, in which research problems are derived from the state of the art, and the construction of empirical evidence is regulated by agreed-upon standards.

The *degree of codification of knowledge*, the degree to which knowledge is represented by formal symbols with agreed-upon meanings, was first suggested as a property of fields by Zuckerman and Merton (1973 [1972]; see also Cole 1983). The degree of codification of knowledge appears to be inversely related to the role of personal interpretation, but there is some counter-evidence concerning the role of personal interpretation in approaches to mathematical proofs (MacKenzie 1999), which is why the clarification of this relationship requires further research.

Together, these two conditions affect the exercise of authority over research goals and approaches. A significant role of personal interpretation and a low degree of codification reduce the influence of the scientific community's knowledge and standards on researchers' decisions. While researchers in these fields still build on the community's knowledge, it constrains the range of acceptable research questions only weakly, and the development of new perspectives that more or less radically re-interpret conventional wisdom is highly valued. Not surprisingly, 'researchers' as young as Master students are expected to formulate their own research questions, and are only advised on their do-ability. By extension, external actors have little success in influencing research questions by equipping researchers with knowledge.

A field's *links to contexts of application* are produced by overlaps in problems, methods and empirical objects between the field's research and society (Gläser 2000). Such links make fields of research relevant to external actors, who may attempt to influence the directions of their research. Thus, the variety of actors and modes of influence applied, that is, the diversity of authority relations, is likely to be increased. Since contexts of application are a potential source of knowledge, materials and instruments, links to these contexts increase opportunities for external actors to equip researchers.

Finally, a field's high *resource intensity* – the extent to which the production of knowledge depends on material resources and labour – makes it more dependent on the provision of resources by external actors. This is why both external actors and researchers involved in funding decisions have more opportunities to exercise authority by equipping researchers with money and other material resources.

These few considerations, which are still tentative due to insufficient empirical evidence, nevertheless highlight the importance of field-specific epistemic conditions for the comparative assessment of the exercise of authority over research content. An underappreciated political consequence of this relationship is that governance instruments which are applied uniformly across a wide range of disciplines are likely to have the intended effects only in some of them, and different unintended effects in many.

RESEARCHERS' RESPONSES TO THE EXERCISE OF INFLUENCE ON THEIR RESEARCH

The modes and forms of influencing researchers discussed in the previous sections form the building blocks of all governance instruments and processes. Whatever the structure of a governance instrument, the influence on research content exercised with it can be traced back to the actors to whom the instrument grants authority and to a combination of the four basic modes and two forms of influence.

Influence is exercised by modifying the situations in which researchers make decisions about research goals and approaches to solving them or by making researchers re-interpret these situations. In this section, I consider how situations are shaped and perceived, and how researchers respond to the situations they perceive. This account offers a highly stylised model because laboratory studies demonstrated that decisions on research goals and approaches are as much 'muddling through' as any other decision, with researchers responding to opportunities and perceiving influences at different times and in different contexts. Nevertheless, a model of conscious decision-making is important for identifying the mechanisms linking influences on researchers to changed research content under specific circumstances.

Decision Situations

The overlap of actors' interests in changing research content and of their opportunities to exercise influence produces a system of authority relations. These authority relations overlay the social order of scientific communities, the knowledge on which researchers build, and the emergent community preferences. In order to continuously conduct research, researchers need to select problems and approaches that create a sufficient agreement between their own interests, the community's expectations concerning relevant and reliable contributions, and expectations by external

actors. These interests and expectations must be aligned if research problems are to be not only technically but also practically doable (Fujimura 1987). Depending on the epistemic distance between the three interests, researchers may not face a dilemma at all, face varying discrepancies that force them to compromise, or face the necessity to follow one of the expectations at the cost of neglecting others.

Two types of situations do not confront researchers with alignment problems. A first type is the decision situation of members of the scientific elite. Members of the elite shape their community's knowledge and preferences through their contributions and authority, which makes it likely that scientific communities will defer to the judgements of their elite. A researcher's elite status is therefore likely to legitimise deviations from both community and external expectations, which is why members of the scientific elite often can acquire resources even when their research interests deviate from community and external expectations (Morris 2000: 434). Members of the elite can also create favourable conditions for themselves within their research organisation, as the 'head hunting' in the context of the British Research Assessment Exercise / Research Excellence Framework (Johnston and Farrar 2003) and the treatment of grantees of the European Research Council indicate (Edler et al. 2014).

A second situation of reduced conflict occurs when interests of researchers coincide with preferences of scientific communities and external actors. This is common in many application-oriented fields such as engineering. Researchers in these fields are very likely to formulate research goals that simultaneously meet the expectations of their community and external actors (Gläser 2000). Similarly, researchers interested in collaborative interdisciplinary research are likely to meet external expectations. Even researchers interested in traditional, disciplinary, basic research that does not promise any applications might still find external actors funding such research.

If researchers' interests, community expectations and interests of external actors do not sufficiently overlap, researchers have to balance their decisions in order to ensure the continuation of research. This means they have to self-identify for research problems and approaches that simultaneously

- are likely to be individually successful, that is, constitute relevant problems and can be solved with the accumulated knowledge and in the current work environment;
- are relevant to their community's knowledge production, that is, promise new knowledge that is needed by the community and meets the community's methodological standards;

- meet any external expectations on which the continuation of research depends.

Each of the three requirements is subject to variation and thus contributes to the diversity of decision situations. For example, a researcher's biography and work environment may make them consider a wider or narrower set of problems as relevant and solvable, and shape the spectrum of approaches accessible to them. Leaders of large research groups have more opportunities to formulate problems meeting both community and external expectations than leaders of small groups or single researchers. Epistemic conditions of actions may also affect the decision situation (see section 'Epistemic Conditions of Action Modifying Authority Relations' above). Finally, the specificity of external interests and the authority of actors backing them vary. Researchers might face inconsistent or outright contradictory expectations from different external actors.

Responses by Researchers

For the discussion of researchers' responses to their situation, we can draw on the literature on organisational responses to their environments (Thompson 1967; Oliver 1991; Pfeffer and Salancik 2003 [1978]). The situation of researchers resembles that of organisations because both must solve the problem of maintaining a core activity under conditions of turbulent environments. Indeed, research groups have already been termed 'quasi-firms', albeit without applying corresponding theoretical considerations to them (Etzkowitz 2003). Using this analogy, we can distinguish between responses that change the environment, the conditions of research, or the content of research in order to achieve the continuation of research in the light of conflicting expectations.

Some researchers can *smooth their environment* by proactively shaping expectations of external actors (see also Leišytė 2007 on 'manipulation'). Researchers can exploit the dependency of external actors on scientific expertise and involve themselves in the denomination of positions, the formulation of missions for organisations, or the design of funding programmes. However, only few elite researchers have this opportunity to inscribe their research interests in governance instruments.

Buffering denotes the creation of reserves that can be used if supply changes. Researchers use buffering in two forms. First, they 'hoard', that is, apply for more resources than they actually need in order to cope with cuts and with the risk of failure. Researchers holding several grants at once reduce the risk of being forced to comply with external interests they see as detrimental to their research. This buffering by applying for more

grants becomes more important under conditions of decreasing success rates of competitive grant funding but at the same time contributes to that decrease.

Second, researchers use resources that were dedicated to one particular purpose for another. This practice of ‘bootlegging’ was first described by Hackett (1987: 143; see also Laudel 2006). It often is very important because the exercise of authority through equipping research implies that more and more resources are provided for specified research projects, which makes work on suddenly occurring new ideas or preparatory work for starting new lines of research increasingly difficult to fund.

Researchers can also respond to external expectations by *window-dressing* (or ‘symbolic compliance’, Leišytė 2007). Owing to the uncertainties involved in the formulation of problems and approaches, researchers can often claim that their proposed research meets external interest by simply changing the language in which the research is described, without adapting its content.

If window-dressing is not possible, researchers need to *adapt their research content to anticipated or actual external expectations* by managing their research portfolios. The concept ‘research portfolio’ indicates that researchers work on more than one line of research at the same time or can construct potential lines of research which could be followed if need be. This was indeed the case with many of the researchers in Australia and Germany (Gläser et al. 2010). Researchers who have such a portfolio of lines of research can respond to differences between external expectations and their own interests in three ways. They can drop ‘unfundable’ lines of research and continue with those meeting external interests, start ‘fundable’ lines of research, or change existing lines of research according to external expectations (‘compliance’, Leišytė 2007). These responses include elements of buffering because researchers try to fulfil external expectations with part of their time and resources in order to follow their interests with the other parts.

Researchers who work on only one line of research that does not match external expectations have only one of two options. They can change its content to achieve a match with external expectations, which may imply giving up their own interests or working on topics irrelevant to their scientific communities. Alternatively, they can attempt to cope with the consequences of not receiving funding, which include scarcity of resources or time.³

The opportunities for researchers to respond to influences on the content of their research are modified by epistemic conditions of action (Figure 21.2). If the role of personal interpretation is high (and the degree of codification low), claims about a particular research problem meeting

Figure 21.2 Modification of researchers' responses by epistemic properties

external interests are more difficult to check. The degree of codification has a contradictory impact on the researcher's room for manoeuvre. A high degree of codification connects many research problems through theories and standardised methods. This makes it possible to claim relevance to external interests for a wider range of problems, which reduces the pressure on adaptation. However, a high degree of codification also makes it easier for a researcher's peers to check claims concerning a research problem's relevance to external interests, which increases the pressure on adaptation.

Links to contexts of application and resource intensity also affect the opportunities for researchers to respond to external expectations. A field's relevance for applications attracts funding and thus provides more opportunities for smoothing, that is, for the initiation of funding programmes and research contracts that meet the researchers' interests. Since higher resource intensity implies that more resources are provided to the field, and application-relevance implies the existence of additional sources of

funding, these two conditions increase opportunities for buffering through ‘hoarding’ and ‘bootlegging’. Bootlegging is further supported by a *high decomposability of research*, that is, the possibility to split a research process into a sequence of separate steps. This increases the granularity of research processes, which supports bootlegging by enabling the highly specified bootlegging of small amounts of resources.

CONCLUSIONS

In this chapter, I proposed a framework for the systematic consideration of ways in which actors outside scientific communities can influence research content. It turns out that the governance of research employs very few modes of influencing researchers. The analysis of these modes and their accessibility to actors interested in influencing research content enables some theoretical and policy conclusions.

Theoretical conclusions start from the observation that all attempts to change research content are processed by individual researchers or research groups, where they are mediated by the self-identification of researchers for tasks and constrained by the knowledge and expectations of scientific communities. The latter’s influence is further strengthened by the dependency of external actors on expert knowledge on the relevance and do-ability of research problems, which is often monopolised by scientific communities.

From this follows, first, that radical change of research content is very difficult to achieve. The self-identification of researchers for tasks creates a strong path-dependency of problem formulation because researchers construct relevant solvable problems with their existing knowledge and in view of their current abilities. This makes incremental change of research far more likely than radical change. Radical change nevertheless does take place if new avenues of research become possible due to discoveries or the development of new methods (Laudel and Gläser 2014). This radical change is endogenous and difficult to predict. External actors can attempt to increase its likelihood by promoting ‘breakthrough research’, by concentrating resources on the exploitation of endogenous radical change, and by concentrating resources for accelerating and scaling up incremental change. Generating radical change, however, is rather difficult for them.

Second, it is very difficult for any actor to make researchers produce specific knowledge. The translation of interests and recombination of influences involved in the exercise of authority over research content make it unlikely that an actor’s original interests are implemented unchanged. Since interests in specific knowledge *not* being produced are easier to

implement and compliance is easier to check, one of the fundamental asymmetries of influencing research content is that the production of specific knowledge is far more easily suppressed than effected.

Third, it is very difficult to causally ascribe any change in knowledge to a specific external influence or governance instrument. Following any specific influence through to its effects means tracing it to the decision situation of researchers and assessing it against all other influences on that situation. While this is not impossible, the methodological challenges are enormous. Ascribing macro-level change to governance is even more difficult because complex – and so far largely unknown – mechanisms aggregating micro-level change additionally come into play.

Fourth, the influences on research content are modified by field-specific epistemic conditions of research. One of the most important contributions of the sociology of science to the study of political influences on research content is its insistence that researchers and scientific communities are necessary to translate this influence. Therefore, any attempt to create theoretical accounts of governance changing research content must systematically and comparatively address the nature of their work.

The analysis presented in this chapter also supports some general conclusions concerning conditions for and effects of science policy. A first conclusion follows from the constraints on influencing research content. With the few exceptions mentioned, nobody – not even members of scientific communities – can make researchers produce particular knowledge. Under these constraints, the major mechanism through which external actors can change research content is equipping the ‘right’ researchers by redistributing resources from researchers whose work does not meet external interests to those whose work does. This leads to meso- and macro-level management of research portfolios by actors who have the means to equip research. External actors identify researchers and fields that meet their interests in topics, approaches or quality, and invest in these researchers. If their interests are not met, they withdraw their investments. This strategy is currently emerging in public research organisations and national science policies (Laudel and Weyer 2014; Gläser 2016).

A second conclusion can be drawn from the observation that field-specific epistemic conditions of research contribute to an immense diversity of researchers’ decision situations. Successfully influencing research and avoiding unintended consequences requires that the epistemic diversity of researchers’ decision situations be matched by an institutional diversity of governance instruments. Institutional diversity increases the likelihood of matches between external influences and decision situations and thus reduces the likelihood of governance failing or producing unintended responses. It should be emphasised that institutional diversity means the

diversity of interests rather than governance instruments. If, for example, all publicly funded actors in a system are sworn to the same state priorities, this homogeneity can easily create problems for whole fields (Laudel and Weyer 2014, see also Whitley, Chapter 11 in this volume).

A final conclusion concerns the distribution of means for exercising influence. In a knowledge society, scientific knowledge itself has become a central means of exercising influence because it equips actors and can be used to suggest to them a re-interpretation of their situation. Since scientific knowledge has become an important tool, the ability to wield it – to acquire the knowledge that furthers one's interest – has become a point of contention in society. Our analysis of modes of influence and the ways in which they can be used to influence research content shows that there are only few means to exercise such influence. These means are very unevenly distributed in society. To put it in a nutshell: knowledge is power, and money is knowledge. Society needs to pay more attention to the distribution of authority over research content.

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NOTES

1. In contrast to earlier attempts at systematising modes of exercising influence (Gläser and Schimank 2014; Berlin Script Collective 2017), which drew on Parsons' distinction of generalised media, this approach distinguishes reasons why Alter might act differently.
2. For a third mode, technologically mediated influence, see Berlin Script Collective (2017).
3. Responses to scarcity include the use of research student projects whose funding is guaranteed from other sources, selling services to commercial customers and using the income to fund research, 'stretching' research by interrupting it when there is no time or funding, and reducing the empirical basis of research by choosing cheap objects or methods, or reducing the number of experiments or observations (Gläser et al. 2010).

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