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Between the Fat-pill and the Atomic Bomb:

Civic Imaginations of Regimes of Innovation Governance

Ulrike Felt and Maximilian Fochler

At the beginning of the 21st century, innovation politics is seen as an ever more central area of public policy, and as a key means shaping contemporary society. In this respect, the title of a recent policy paper issued by the European Commission on the European Research Area is quite telling: "Inventing our common future" (European Commission, 2007). On the designed cover page of this policy brochure, as well as in the discourse within the document, a direct connection is drawn between the organisation of European research and the future of the European knowledge society. In a nutshell, this title slogan exemplifies two key assumptions characterising current debate on innovation. First, that the future is open to be shaped by human action in our present, and that the prime means of doing so is by techno-scientific innovation. This resonates with the diagnoses by key analysts of the changing social and epistemic organisation of science, who stress that visions of future applications play an increasingly important role in research today (Nowotny et al., 2001). Second, that this process of constructing "our" future needs to involve some social "we", though the precise nature of this "we" remains vague and undefined as much in the quoted policy document as in many others of the same genre produced in national policy contexts. Particularly in the European context, with its history of controversial public debates about innovations e.g. in the area of agricultural biotechnology (Levidow, 2007), the idea that scientific progress quasi automatically equates societal progress, seems hard to sustain. Some process of governance with broader participation is seen as needed, as the policy paper's call for public consultation also shows. Yet also the question of when such public engagement should take place is increasingly addressed suggesting that it should take place much earlier in the innovation process, an idea captured by the notion of "up-stream engagement" (Wilsdon et al., 2005).

The relation between envisioned future social orders and techno-scientific innovation sketched in this example raises crucial democratic issues, particularly on whom is meant by the 'we' that is imagining and constructing techno-scientific futures, and whose voice is considered when negotiating and shaping innovation processes. These are topics intensely debated both in policy and academic discourses around governance and public participation. However, an often-neglected issue in these debates is the intertwinedness of participants' tacit understandings of the form, structure and dynamics of technoscientific innovation processes with their visions of governance and participation. To address this gap in the literature, the present article investigates to what extent, and what kinds of, tacit understandings of innovation and governance are shared by members of a specific socio-cultural context. This will then suggest how specific cultural forms of conceptualising innovation are seen as opening up or closing

down particular possibilities of governance and public participation and as privileging involvement of certain actors and not of others.

To accomplish this, our attention will not be directed towards tacit assumptions about innovation informing policy discourses. Rather, it will be focussed on the different understandings of innovation and the roles they play when scientists and citizens attempt to resolve questions of governance over technoscience in a shared discussion space. We will analyse (1) the examples they build, (2) the topics they argue over and (3) the arguments they take part in. These often represent a broader societal repertoire of myths and narratives about innovation and form a crucial but often neglected part of societal ways of dealing with new techno-scientific knowledge and technologies. Public engagement processes – as the one this paper draws the data from – provide a particularly rich analytic window to understand how cultural models of innovation impinge on how governance and public participation are framed. Participants use stories about innovation to position themselves, identify problem zones and make certain claims, while also trying to make sense of the exercise they are part of and their own role in governing techno-scientific innovation.

Before detailing our empirical findings, we will set the stage by discussing three important theoretical debates framing our argument. First, we will briefly revisit central models of innovation and how they have been and are influencing the policy process. Second, we will discuss the recent discourse around governance and public participation, with a particular emphasis on ideas about innovation governance. Third, we will sketch our perspective on regimes of innovation governance as a crucial part of contemporary techno-political cultures. We will then describe the public engagement experiment, upon which we base this paper's central argument. We follow by explaining the methodology, both for conducting the research as well as the analysis. We will elaborate on the ways in which innovation was (often implicitly) conceptualised and used as argument in the debates, and how these relate to participants' imaginations of governance and public participation. Building on this, we will draw conclusions on how the intertwinedness of 'imaginations of innovation and participation' poses new challenges for democracy in contemporary knowledge societies.

Technoscience, innovation and governance: Techno-political cultures matter

Models, Myths and Regimes of Innovation

Arguably, the model that has most strongly influenced 20th century academic reflection, policy making, and public discourse on innovation is the linear model of innovation. In a detailed history of this model Godin (2006) traces its genealogy in three phases. The first, ending roughly in 1945, focussed on the separation of basic and applied research, strongly guided by the ideal of a pure science as an autonomous social system operating untouched by broader public scrutiny. In the subsequent second and third phase in the 1950s and 60s, the stages of product development and diffusion / market innovation were added to the model, thus extending it into society yet leaving the basic idea of the autonomy of the first stages untouched.

In its well known three or four stage form, the linear model has four main characteristics relevant for our argument, all of which have been amply criticized both on empirical and normative grounds. First, it assumes a clear distinction between the respective phases of innovation as well as the actors and institutions associated with them. Second, these phases and actors are seen as related in the form of a one-directional chain, which implies an innovation flow from basic science to marketable products without significant feedback loops. Third, there is a strong notion of technological determinism underpinning the model. Often, the form of the linear pathway is seen as strongly influenced by "inherent" characteristics of the knowledge or technology to be realised. Choices between alternative pathways of innovation and technological development mostly remain black-boxed (Pinch & Bijker, 1987) and are retrospectively reconstructed in the logic that 'the intrinsically best solution wins'. Fourth, from a governance perspective, the linear model ascribes a clearly passive role to societal actors, whose role as consumers is at best to adopt a product or to conform to a development, rather than to participate in shaping it.

However, as Godin (2006) shows, to criticize the linear model for being simplistic is not a privilege of science studies. Indeed, criticisms of this kind have accompanied the model at all stages of its development, often expressed in the very texts promoting its use. As such, the model has to some extent always been more of a myth than a model – a narrative providing guidance and basic orientation rather than a description of empirical realities. As a myth, its discursive hegemony is also grounded in its implicit cultural rehearsal in multiple settings, in stories that are retold in many different instances and rituals, in policy, science communication, and everyday life. Discursively linking Einstein's scholarhip to the CD player and Geographic Positioning Systems (GPS) represents nicely what we mean by rehearsal of innovation myths.[1]

At the beginning of the 21st century however, we might presume the mythical character of the linear model to be more obvious than ever. It is challenged by a range of eminent contributions widely read both in policy and academia offering alternative models of the relation of science, economy and society. Nowotny et al. (2001) – to take but one of the most prominent examples – have coined the term „mode 2" science, which stresses that scientific knowledge production ever more strongly takes places in the context of its (future) application, thus eroding the boundaries between science, economy, and indeed society. In a similar vein, Etzkowitz and Leydesdorff (2000) diagnose an ever-closer intertwinement of academia, industry, and government.

Still, as Godin (2006) argues in line with other observers (e.g. Felt & Wynne, 2007), despite regular proclamations of its death, the linear model as a 'social fact' is still a very dominant imaginary of innovation informing policy and public discourse, while efforts to replace or challenge it with alternative, less linear, unidirectional and hierarchic ideas such as open or distributed innovation have enjoyed only rather limited success. In his argument, this is due to the fact that the linear model has been deeply inscribed in the statistical practices in the monitoring and governance of research systems. As such, the role of the linear model in current policy practice may also be theorised as that of a regime of innovation, in the sense of an "institutionalised paradigm of how things must be done" or thought (Felt & Wynne, 2007, p. 22). A regime, in this use,

[1] See for example http://www.einsteinjahr.de/page_64.html.

is an institutionalised set of rules and practices guided by specific models of innovation.

In the context of current European policy texts, linear notions coexist and blend with other regimes of innovation, such as the "economics of technoscientific promises" (Felt & Wynne, 2007), in which projections and fictions of future applications to solve societal problems assume a central role guiding and structuring the innovation process. In the context of the Lisbon agenda (European Commission, 2000), these projections are always discussed as inextricably linked to generating economic wealth, and to securing Europe's place in global economic competition. Here, currently a strong aspect of economic teleology may be observed in current regimes of innovation. How to best govern the innovation process to achieve these ends is seen as the key policy challenge. In this, one of the main policy preoccupations is to create a climate fostering innovation – which often mainly refers to avoiding the intense public resistance commercial applications of particularly agricultural biotechnology have received over the past years. Hence, the public receives a particularly prominent role in the recent debates around the governance of innovation.

Governing Innovation – Innovating Governance?

The rising importance of techno-scientific innovation in much of European policy discourse has been accompanied by much attention and debate devoted to the governance of these very innovation processes. Two notions have been central to these debates: governance and (public) participation. Governance refers to new decision-making structures that go beyond the rules and processes of classical government, mostly involving non-governmental actors in policy-relevant decision-making (Jordan et al, 2005). With the involvement of these new actors in policy-making, decision-making constellations shift from the top-down model that is characteristic of 'government' to network-shaped structures that exemplify 'governance'.

In this, the rhetoric of governance especially for issues of science and technology often quite openly embraces public participation as a bottom-up complement to traditional approaches of doing politics, supposedly de-centralising the framing of policy issues or processes of regulation. On the level of the rhetoric of policy documents (Hagendijk, 2004), the European discourse on science-society relations, at first glance, seems to have shifted away from notions inspired by the deficit model, which conceptualises science communication as a unidirectional effort in which an ignorant public is to be educated to raise its propensity to consent to techno-scientific innovation. Instead, references to a 'true dialogue' abound, and indeed Europe has recently seen an unprecedented number of participatory experiments to involve the public in the debate around issues of techno-scientific innovation.

However, as a number of critical contributions argue, the precise relation of these experiments to actual processes of government has more than often remained vague and unclear. Goven (2006) points out that governance's agenda to de-throne top-down government may not only be read as a democratic move towards less hierarchical and more inclusive forms of political processes. Much more, she interprets the recent shift to governance as part of a neoliberal gambit to de-center the policy process, to shift influence to powerful corporate stakeholders, while at the same diffusing political responsibility and accountability. In this, the public as the final arbiter of tradi-

tional democratic politics is on the one hand reduced to being one stakeholder among a group of others. On the other hand, representations of the public are narrowed down to specific invited mini-publics, which conform to policy makers' expectations of 'citizens without prior interests', or as 'idiots' in the ancient Greek political meaning of the term (Lezaun & Sonneryd, 2007). Recent work on public participation has indeed shown that two of the major issues that lay participants in 'participation exercises' struggle with are (1) the vagueness and opacity of the governance process they are expected to relate to and (2) the reduction of 'the public' to a relatively small citizen group (Felt & Fochler, 2008).

Hence, the seemingly more participatory "new scientific governance" merits critical investigation, as Alan Irwin (2006) argues. In a detailed discussion of recent European and UK policy papers and initiatives, he shows that central assumptions of the deficit mode of science-public relations remain alive in the talk about dialogue. He concludes that the "old nexus of technocratic aspirations with the public construed as an obstacle to progress" (p. 316) may still be identified. Dialogue, in the meaning of this policy discourse, is merely a method hoped to be more efficient in reaching societal consensus on innovation trajectories pre-framed by economic and political visions such as the Lisbon agenda. This reflects the distinctly teleological nature of current innovation regimes in European policy discourse, in which the future to be "invented together" is strongly pre-defined – or, to put it more precisely, in which the basic criteria by which the quality of potential futures are to be evaluated are closed down and not seen as open to public scrutiny and debate.

The differences between this particular enactment of' 'participatory innovation governance' and critical STS scholars' vision of a more participatory governance of innovation processes may best be exemplified using the debates around the idea of "upstream engagement". The academic advocates of this new approach to engagement (Wilsdon et al., 2005) criticize much of prior and current practice in public participation for situating participation too far 'downstream' in the flow of innovation. Hence, the questions addressed in these processes are mostly related to the risks of particular products or applications, while they fail to address broader issues and societal choices that are already closed at this point in the innovation process. In the view of this model, innovation governance should take place "at a point where research trajectories are still open and undetermined" (p. 38), and when fundamental decisions in these trajectories are still amenable to governance and public scrutiny. However, similarly as for dialogic approaches to science communication, the policy uptake of this idea differs strongly from this vision, as policy institutions fail to recognize the need to open up their institutional commitments and assumptions to public debate (Wynne, 2006). As a result, downstream questions about risks are asked at supposedly more upstream moments in the innovation process.

Joly and Kaufmann (2004) have criticized the basic metaphor underlying the notion "upstream engagement" as implicitly referring to the linear model of innovation, and as de facto reducing it to two hardly defined poles – "one is never either upstream nor downstream, but always at some specific point – […] midstream? – in the production of knowledge" (p. 231). In order not to fall into the trap of Collingridge's dilemma and its implied trade-off between knowledge of the properties of the outcome of an innovation process and the possibility to influence the innovation trajectory, they

suggest a more fine-grained basic model of the innovation process is needed, which allows for "ongoing, step-by-step evaluation" and governance.

Techno-political cultures and regimes of innovation governance

Both the development of scientific knowledge and of the technologies related to this new knowledge have to be understood as embedded in what could be labelled techno-political cultures. At the same time, the specific ways in which new knowledge or new technologies are woven into a society re-enact and possibly also re-shape these very techno-political cultures. For addressing the nexus of science, technology, and the respective social issues related to them, this implies the necessity to move away from a universalist and de-contextualised framing of 'the problem' at stake. What seems needed is a much more fine-grained analysis of the specific techno-political contexts in which both innovation and innovation governance, but also their public perception are embedded.

Hecht's work on techno-politics as the "strategic practice of designing or using technology to constitute, embody or enact political goals" (2001, p. 256) is a useful starting point for addressing these issues. Referring to both technological artefacts and practices as constitutive of 'technology', she stresses that grasping the intertwinedness of technological innovation, political processes and societal values is a key issue for the analysis of technoscience/society relations. In her own work, Hecht has particularly analysed this for the inextricable relation of national identity and notions of technological progress in the case of nuclear power in France. She describes two relational configurations of how a technological innovation may successfully enter this techno-political context: either by "making a French technology" or "making a technology French". (p. 278) Hence, as other comparative studies also suggest (Felt et al., 2008), the processes in which a particular technological innovation may or may not be 'nationalised', or in broader terms integrated into the value systems of the respective social collective, are of key importance for understanding innovation governance and its public perception.

This nicely ties into recent work by Sheila Jasanoff (2005), which from a comparative perspective analyses how different political cultures deal with issues of technoscientific innovation. Studying biotechnologies she suggests that "modern technoscientific cultures have developed (distinct) tacit knowledge-ways through which they assess the rationality and robustness of claims that seek to order their lives" (p. 255), which she terms "civic epistemologies". Science and technology once on the public scene have thus to compete with other knowledge claims and it becomes essential to understand how credibility is established and how this might differ between political cultures.

Our analysis of 'civic imaginations of regimes of innovation governance' in this paper builds on both Hecht's and Jasanoff's work. In conceptual terms, it most strongly draws on Hecht's (2001) concept of "technopolitical regimes", which she defines as grounded in institutions and consisting of "people, engineering […] practices, technological artefacts, political programs, and institutional ideologies which act together to

govern technological development" (p. 257)[2]. This concept not only allows us to address policies and practices around material technological innovations, but also how "broader visions of the socio-political order" (p. 258) are negotiated and pre-scribed in earlier stages of the innovation process.

This is of particular importance since in this paper we will not focus on technological realisations of genome research, or their materialities and related practices. Rather, we claim that the analysis of techno-political cultures should take a close look at imaginaries and expectations of innovation processes themselves; and it should consider the way innovation is conceptualised as a complex translation-machinery that re-combines technoscientific knowledge, artefacts, actors, institutions and governance structures to assemble techno-scientific futures. In the technological metaphor of a machinery, models of innovation may be read as scripts (Akrich, 1992) of these machineries, which pre-scribe certain constellations of governance, in the sense that they open up or close down political imagination as to how, when and by whom techno-scientific development may be governed. These political imaginations in turn need to be articulated against the backdrop of an existing techno-political culture and its institutional logics. To capture this complex constellation of innovation models and imaginations of governance within a techno-political culture we will employ the term 'regimes of innovation governance'.

By using this concept in our analysis, we would like to enlarge Jasanoff's dimensions of civic epistemologies, by looking at the ways in which people experiment with the repertoire of regimes of innovation governance they can draw on or re-configure from resources and experiences in a given techno-political culture. We thus are paying less attention to the ways in which participants deal with knowledge claims as such, but rather how they imagine and experience the transformation/translation processes between knowledge, and some kind of artefact or practice, and social orders.

Scrutinising civic ideas of such translation-machineries leads to broader democratic questions, such as who could participate in shaping this process, when and how. Latour (1998) criticises that although contemporary societies are quite aware of the strong transformative potential of science and technology, they still mostly conceptualise science and technological innovation in rather classical terms: Science as detached from "the shackles of ideology, passions and emotions" and hence society (Latour, 1998, p. 208) and innovation as the linear transformation of this science into ever better technologies. He suggests that current science/society relations are better described by using the term "research", in which scientific knowledge production and technological development are much more intricately entangled with societal logics, hopes and values. Innovation, then, is in his terms better seen as a form of "collective experimentation". In a regime of experimentation, innovation is not an effective transmission exercise, but a major political trading zone of contemporary societies.

Building on Latour's argument, we ask if, and in which forms, societal actors, such as citizens and scientists, envision innovation as a kind of collective experimenta-

[2] In our use of the term, this concept may be seen as extending the notion of 'regimes of innovation' introduced earlier in this paper. While 'regimes of innovation' addresses the institutionalisation of certain models of innovation in governance structures, 'technopolitical regimes' adds the idea that this institutionalisation needs to be articulated in a form which is recognisable in a given technopolitical culture.

tion – and what this precisely might mean for the democratic qualities of the innovation process. Hence, we argue that interesting articulations that embody cultural understandings of innovation can be revealed in the macro-domains of policy or mass media. And indeed, they may also appear in the myriad of micro-process by which citizens struggle to make sense of the ever more important nexus of science, technology, innovation and governance. Our central aim is to get a glimpse of these latter processes, and to study the repertoires of models/regimes by which citizens make sense of innovation, and their implications for governance. To support our argument, we rely on the analysis of data collected during an ('upstream') public engagement experiment. We believe that experiments like these more robustly elicit citizens to reflect on how they conceptualise and address the relation of innovation and governance.

'Let's talk about Genomics': Setting and Method

This article is based upon a 'collective experiment' in public engagement conducted in Austria during 2004/05, concerning the ethical and societal dimensions of genome research. Our 'experimental design' selectively modified a number of key elements and dimensions of classical participatory projects to investigate several hypotheses about participatory events.

The central thesis of our study argues that even though public engagement is often framed as a 'true dialogue' between scientists and citizens, scientists quite often take very reductive roles in public engagement designs. In many classical engagement models (e.g., consensus conferences), the idea of the public 'talking back to science' is taken so far that there is actually very little room left for scientists to participate outside of their role as providers of 'expertise'. Hence our first objective was to insure that both citizens and the scientists may engage in the process on an as equal level of involvement as possible.

The asymmetry of involvement in classical engagement models led us to consider another factor: the length of the engagement process. Our second objective then was to increase the time and frequency citizens and scientists could interact, and reflect upon their discussions between sessions, in order for mutual comprehension to become possible. In this way, we hoped to be able to observe how social relations between scientists and citizens would develop, and how they would impinge on for example the citizens' assessment of the ideal of scientific self-governance scientists put forward, or on the scientists' view on the idea of public participation. Furthermore, the length of the process would also allow participants to collectively shape the very process of interacting with each other. Thirdly our objective was to explore what having an up-stream debate might mean in a concrete setting and its possibilities and limits.

To fulfil these 'experimental parameters', we chose to adapt a design developed by the Swiss foundation Science et Cité—the Round Table[3]. Its basic principle is to have a group of citizens consider a topic over a longer period of time. The Round Table is strongly process-oriented and the precise structure of the engagement design is not

[3] See http://www.science-et-cite.ch/projekte/tableronde/de.aspx, last accessed 8 February 2007.

pre-defined, but should be developed by the participants in the ongoing process. Further, in order to keep the discussion as open as possible, there is no pre-defined output, thus relieving pressure on the group to produce a final consensus statement.

Our project Round Tables assembled fourteen citizens from all over Austria and thirteen Genome researches working in a large research consortium dedicated to the study of lipid metabolism associated disorders. Their research project served as a thematic 'anchor' to spark discussions upon the social and ethical aspects of genome research. It fulfilled our project's third requirement in that it had a clear and explicit vision of the societal problems to be addressed (obesity, diabetes), but still was quite far from any possible clinical or other application. Thus, the genome research project was—as a 'basic research' project—situated quite far 'upstream' in a possible development of an application, while at the same time already incorporating—even though very vaguely—promises for the future.

The citizens were selected from a nation-wide call for participants using bulk mailing, distribution in popular universities all over Austria, museums as well as newspaper adds. Our 'technology of representation' mainly focussed on achieving as much heterogeneity as possible concerning the experiences people brought with them and the way they related to the topic. Our sampling procedure aimed at capturing as diverse an array of attitudes towards the issue, while reflecting a balanced distribution of gender, age and formal education in the group. In the end, our citizens group was quite evenly distributed along gender and age, but was over-represented by those with higher education.[4]

The scientists were 'recruited' via a project internal call. In total, thirteen scientists enrolled in the Round Table, eight of which participated on a regular basis. The sample of researchers reflected senior, mid-level, and junior as well as pre and post-doctoral researchers.[5]

The actual Round Tables were whole-day discussions, which took place in a reconfigured seminar room at the researchers' laboratory. A series of six meetings was held over a period of about eight months. The first three were dedicated to discussing the different sub-projects of the genome research itself including a laboratory visit. During these Round Tables the participants collectively identified topics to be discussed in the remaining meetings: (1) science and the media, (2) ethical issues of genome research and (3) regulatory issues. A 'outside expert' not associated with the research laboratory was invited for each of these thematic discussions (a journalist, an ethicist, a representative of a state regulatory body). A seventh meeting was organised for the lay-participants to reflect upon their experiences in a broader sense.[6] The Round Tables were facilitated by an 'outside researcher', specializing in Science, Technology and Society (STS) scholarship, but was not part of the project team. Generally

[4] Gender distribution was even. Age: Out of a total of 14, four participants were 18-30, five 31-45, four 46-60 and one above sixty. Education: University Degree: 8, A-Levels equivalent: 5, below A-levels: 1;

[5] The gender ratio not surprisingly showed a strong negative correlation with the hierarchical position – all project heads were male and nearly all doctoral students female. These hierarchies were reflected in the discussion, where the younger scientists were much less likely to contribute without being explicitly addressed than their senior counterparts.

[6] The level of participation at the single Round Tables was generally very high, the lowest number of participating scientists at a discussion being five, and the lowest number of present citizens being twelve.

discussions took place in the plenary, however, at some Round-Table meetings, small group discussions were included in the design to allow for varied interaction dynamics, or to develop inputs for the plenary in a smaller setting.

Qualitative interviews were conducted with all participants before the first and after the last Round Table to trace potential changes in the participants' positions and opinions. Along with a number of other topics, perspectives on governance and public participation were an explicit topic in both these pre and post interview rounds.[7]

All discussions and interviews were taped, transcribed and coded with atlas.ti software. The analysis was done in a grounded theory approach (Strauss and Corbin, 2000).[8]

Imagining innovation and technoscientific governance

The following analysis addresses the main topic of this article, the co-production of 'notions of innovation and governance'. A central objective of our Round Tables was to initiate and nurture debates about (1) the possible future innovations emanating from the Genome research project featured in this study (2) how these developments embodied ethical and social implications, and ultimately (3) about how the resulting socio-technical architectures may be governed[9]. To incorporate these three analytical themes, we focus on how our citizen and scientist participants conceptualised (1) processes of innovation, (2) the actors associated with them, (3) which resources they drew upon in doing so, and (4) how they assessed possibilities and limits of governance over these various elements. In the following, we do not a priori analytically distinguish between citizens and scientists, because our contention is that for the topic of innovation governance, a re-staging of the citizen/scientist distinction as a simple expert/lay divide should be avoided. Rather we choose to look at all of our participants as members of a society sharing broader cultural resources. Yet we need to carefully reflect that their respective backgrounds and prior experiences may become visible in different ideas of innovation, as well as consider possible hierarchies in claiming and ascribing authority to talk about innovation processes.

On the road to "slim futures"?

Not surprisingly, the Round Table debates were heavily framed by the scientists representing their research aims and interests, and most of all by the social assumptions implicit in these. Consider the description of the project given on its homepage:

> *"In the western world obesity, non-insulin-dependent diabetes mellitus and cardiovascular diseases are epidemic. [...] [M]ore than 50% of the population is overweight,*

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7 The interviews were conducted by members of the project team.

8 Coding was done in two steps. Firstly, discussion and interview segments relevant to the overall topic of this article were identified and coded using atlas.ti. Secondly, these segments were subjected to a fine-grained analysis using open coding.
For the interview passages the following code is used: S ... scientist, L ... lay participant followed by number which corresponds to the list of participants, m/f for male or female; RT ... roundtable followed by the number; PI... Interview made with lay participants after the round tables.

9 Our analysis in this paper focuses on this aspect of governance. For a discussion of other governance topics, e.g. animal experimentation, see Felt/Fochler 2008.

and throughout the world about twice as many people die from cardiovascular diseases such as heart attack and stroke as die from cancer. Among other factors, one underlying cause of all the above-mentioned diseases is dyslipidosis (disruption of fat metabolism). The goal of this project is to discover and explain the function of each gene and protein involved in the process of uptake, storage and mobilization of lipids (fats) by cells." (retrieved 2004)

In Round Table discussions, our scientists would regularly refer to the 'obesity epidemic' as the justification for their work. To them, the knowledge they produced would contribute to a greater understanding of obesity and thus indirectly lead to the treatment of this disease, an aim they viewed as unquestionably positive. Hence, their imagined ideal future was 'slim and healthy', and they often used – although often playfully– this vision as a rhetorical resource in the discussions. Our citizens participants however would raise the issue about whether this research might not contribute to the medicalisation of 'being overweight'. Moreover, they asked whether a resulting treatment – which they symbolically referred to as "fat pill", a construction that we will investigate later in this article – might not increase the pressure on people to conform to implicit societal norms and even lead to a compulsory use of medication to save healthcare costs. Whether a technological fix offered by genome research was the only approach to 'solve' this problem and how it related to others, e.g. psychological, approaches, was also questioned. Hence, citizens were not ready to unconditionally subscribe to the scientists' projected future; And even when subscribing to a "slim future", they would engage in the discursive construction of alternative trajectories along which to arrive at that societal goal.

Not far into these debates, participants implicitly pondered questions central to innovation governance, such as (1) when, where and how the knowledge produced in the particular project may be transformed into applications, (2) how other forms of knowledge might find their place and be considered, (3) which values would guide this process, and (4) whose interests these innovations might advance. In essence, participants were imagining futures through discursive assemblages backed by assumptions on the innovation process and its governance, and about current and future societal needs, wants and values[10].

Linear Concepts of Innovation

In discussing the potentials and limits of governing the knowledge produced, and its uncertain future implications from this particular Genome project, our participants quite frequently employed references to images and narrative elements that approached a linear model of innovation. It should be noted though that in the actual communicative setting of the Round Tables, none of the participants expressed a coherent linear model from which to conclude a certain mode of innovation governance. Rather, they employed a variety of rich narrative images and fragmented arguments that implied basic ideas of linearity in the innovation process.

The most dominant discursive presence of the linear model was during scientist accounts on the 'transformation chain' from knowledge to application. In a series of

[10] For a detailed analysis of the „lay sociologies" employed to construct and contest claims on present societal values, see Felt/Fochler/Müller/Strassnig 2009.

clearly discernable successive steps, scientists recounted the process of basic knowledge production and then incrementally moved towards societal application. A crucial aspect of this idea put forth by our scientists is that each of these steps was associated with clearly discernable actors, places, objects, aims, timelines and rationales. Consider how a scientist would describe the pathway of their knowledge "into society":

> *S6f: [...] We have direct aims, which are ours in the laboratory. Our direct aim is to identify genes and to clarify metabolic pathways. [...]. Then there are indirect and long-term aims [...]. ... to reduce obesity, to reduce arteriosclerosis, heart attacks, cancers and so forth. But these indirect and long-term aims are not our aims. These are only societal aims, which are realised by others – we do not do them ourselves. We cannot even do it. (RT5/2/314)*

Implicit in this quote, and in the broader ideas of linearity in the discussion, is a clear segregation between steps of "knowledge production" and steps "applying the knowledge produced". With important consequences for governance, especially scientists would stress the distance of (their) "pure knowledge production" to any form of application – both in terms of time and personal capacity to realise "slim futures". Asked by an invited ethicist to reflect the ethical implications of his work, a scientist would at first refuse to do so, on the following grounds:

> *S7m: [...] but now you've made the same mistake again, which I already criticized in the beginning. You mistake basic research for application. [...] Basic research doesn't mean that there will be any outcome. If we find some gene, then we have really done nothing else but finding some gene; and it's a long way to anything else. (RT5/2/122)*

The idea that knowledge production is clearly separable and separated from any further transformation of this knowledge very often is grounded in a firm belief that basic science follows a strictly internal rationale, and that outcomes are determined by a pre-given order of nature, untouched by societal values and interests – as this quote from a citizen exemplifies:

> *L1m: How shall I put it, the findings are actually already there in some way, aren't they? I mean, they somehow all float around, and they [the scientists] just discover them. And considering this they probably could not blame themselves of doing something […] particularly negative; because it's there, anyway, and they just discover it. (PI, 331)*

How far science was seen as segregated from society, upon the grounds of the arguments sketched above, varied quite markedly between our two groups of participants. This variation may best be described as a spectrum of positions between two extreme poles – one embodied the ideal of basic science, virtually unconnected to society, and the other, while more or less following a linear model, assumed a dense array of feedback mechanisms between science and societal actors at the early stages of this process.

The former pole of the spectrum was "inhabited" by a very small group of scientists, who were in STS terms committed to a quasi-Mertonian ideal of a segregated science which produces knowledge for knowledge's sake, and which is governed by an internally defined ethos. Especially when challenged to consider the implications

their research may produce in a long-term perspective, this group would argue that their task would be to "produce knowledge in the cultural effort science" and that they wouldn't "feel as if the public had commissioned [them] to produce a product".

Beyond this quite strong boundary work argument, particularly participating citizens assumed that societal interests associated with different actors would feed more or less strongly into different stages of the linear process, and thus also into basic research. Some citizens would refer to the rather general idea that the promise of societal benefits would play a role in research funding. "Society" hence was somehow involved in deciding priorities of the allocation of research funds. Also a number of scientists took up similar arguments in stressing that they were actually working on the "factually given" societal problem of the obesity epidemic, and that they were thus fulfilling an important societal task.[11] Other approaches would (often with some unease) see economic actors as influential 'movers' entering at different points in the process, or they would stress the important role of consumer decisions particularly at the very end of the linear pathway from knowledge to application.

Which implications for governance do the arguments sketched above carry? First, seeing the innovation process as a series of discernable steps implies that before each new step is taken, governing mechanisms may set in – at least potentially. However, these mechanisms were rarely imagined as shaping or re-framing the next step, but almost always as 'stopping' the trajectory of a particular innovation before it enters a new phase. Employing historical references such as the development of the atomic bomb, participants would discuss possible points in time where this eminently tragic process might have been halted, however without reaching any conclusion. Again referring to examples from the history of science, a number of participants argued that such 'passage points' could only be identified in hindsight, or as one citizen put it: "You only know that it's too late when it's too late – and then the point in time which was just before is already past." (L3f, PI, 267) This inability to discern windows of opportunity for governing innovation, and to take the 'right' actions, was however mostly not seen as a problem of the innovation process as such, but, in a variant of technological-determinism, was attributed to the inability of society to decide 'against' certain trajectories of innovation.

Second, participants would rather locate the possibility to govern innovation 'downstream' along the linear process, very often at or around the 'step' of developing the first tangible 'products' or 'technologies'. This is related to the basic assumption outlined above that science follows an internalist rationale and merely 'discovers' things 'out there'. Building on this argument, a number of participants saw knowledge itself as untouched by social values and hence not as an object amenable to governance. Some even extended this argument to technological development, arguing that the societal use of a technology is external to its technological characteristics[12]. Hence only "the use" may/should be governed, but not the development of the technology itself. A consequence of both positions is that governance efforts as well as public participation may only set in as soon as a particular innovation has left the epistemic core

[11] For a detailed discussion of the rhetorical construction and deconstruction of obesity as a "social fact" at the Round Table see Felt/Fochler/Müller/Strassnig 2009.

[12] One rather creative illustration of this argument was that typewriters may be used to "strike people dead".

of pure knowledge production, which is "at later stages" than the upstream discussion taking place at the Round Table.

In the arguments analysed above, governing as an activity is very strongly related to influencing the societal conduct around tangible objects and artefacts in the present, based on factual knowledge about the characteristics of these very artefacts. Especially the scientists argued that governance would be pointless before knowing the facts, an argument which was often supported through using historical evidence. In criticizing some citizens' claim that scientists should take responsibility for the future consequences of their research, a scientist reacted as follows:

> *That will work if I invent a slingshot, then it is foreseeable that if someone will be hit by a stone on the head, and he will die, or whatever. It becomes more difficult of course, if I, as in our case am investigating the metabolism. [...] Mr. Pasteur did not know when he discovered penicillin, discovered by chance, that there will be multiple resistances resulting from that. [...] and at some point in time I will have a problem with that at the hospital. But it is still better to have an antibiotic with resistances than no antibiotic. (S6f, RT5/2/25)*

Implicit in this quote as in many statements about governing innovation subscribing to a linear model is that the ideal form of governing would be making rational decisions based on facts in full knowledge of the properties of the innovation to be governed. That these facts may be framed by prior value-based decisions is alien to this line of thought, rendering ideas of upstream engagement quite exotic and intangible. Instead, a very strong lay/expert divide is enacted in this understanding, as the contribution of those who have expert knowledge about the factual properties of the innovation to be governed is valued higher than those who only may speculate about its societal implications.

Network concepts of innovation

Overlapping and in parallel to the imaginations that innovation happens along a linear incremental process we find different versions of more network-inspired models. In contrast to linear ideas, predominantly citizens enlist network models, and their presence magnifies with the advance of debate. This may be a result of the 'temporal factor'- the longer citizens are involved in the discussion, the more their awareness increases about the different societal forces shaping research, as well as the 'messy nature' of it. In this sense we argue with Latour (1998). While our citizen participants arrived with a rather delimited imagination of science, with time, they were increasingly confronted with the 'culture of research'. As a result, they developed a more sophisticated orientation towards the 'science in society' relationship.

The most dominant characteristic of network models is the idea that innovation does not happen at one single place or point in time, but is distributed over many different sites, involving different actors and value systems. Thus participants' understanding of innovation becomes rather broad and eventually resembled a vision of a complex, messy and often confusing process. One of our lay participants put this rather clearly:

> *L13m: Well, the scientist somehow tries to answer original questions, to publish in as prestigious journals as possible. Journalists try to maximise viewer levels or paper*

> *sales. Politicians want to attract votes. Businesses try to make money. And like this everyone has his own yardstick, against which he measures his activity. And somewhere the circle closes. So, it does not have a beginning or an end so that one might say: If A does that, then B must do this. But somehow that's a closed circle, which just works; and which changes dynamically because of external influences. But in essence everyone moves on his own territory and bases his actions on certain specific criteria, against which he measures his success. And everything he does consequently derives from his personal success …. (PI, 175)*

Implicit in this quote is the idea that each node of the network functions according to an internal logic which is always imagined to correspond to measurable entities – number of papers, number of readers, amount of money etc. – thus following an audit logic. Actors in the network struggle to influence the other players to support their aims. As a consequence, developments are not necessarily directed, have no easily observable overall logic, as forces tear the process in many different directions, and changes in the environment can at any point in time contribute to shifting the balance between the players.

Beside scientists, we find politics, media and business as other major players in these accounts on innovation networks, however with different kinds of power attributed. Economic players are often singled out as being particularly powerful, yet more on an ideological level than directly through financial steering. To account for these hierarchies participants mainly referred to previous experiences or shared imaginations. However players such as science and its members are not necessarily seen as homogeneous entities, but also as characterised by inner struggles over directions to follow and values to subscribe to. Thus how innovation happens is often described as being partly opaque, bewildering and difficult to grasp.

These networks are understood as trans-local. The US is often directly or indirectly referred to as an important economic and scientific player; but also other countries are mentioned, in particular when it is about transgressing values and rules. For example China would be mentioned as allowing animal experimentation on species protected in most other contexts, for example the case of hedgehogs.

Also in the network model, we find quite important variations in how the detailed ingredients and functioning mechanisms as well as the ties that hold together the different elements are imagined. We would like to differentiate between four of them. The first describes a science-centred network, in which science manages to enrol other network member to more or less explicitly support and serve its interest. Here we find a double rhetoric: Even though science is perceived as being part of a larger network of societal forces, there is an important effort made to reconstruct the epistemic core as something that should be no means be touched from the outside. Participants imagined a system where the epistemic core is protected by surrounding institutional structures, which manage to deal with the other network partners in a way that allows rallying support from different societal actors, while keeping them at a distance. In this variant, there is an implicit understanding about how closely intertwined societal and scientific developments are, as well as a simultaneous struggle to disentangle them.

The second type of network model – which we label the invisible hand model – is imagined as driven by a central actor who however remains largely invisible. Mainly deployed by some our Round Table citizen participants, this idea is depicted as rather threatening, the major problem being the lack of transparency. This makes it impossible to grasp who this actual actor is and to understand the respective logic of action. As a consequence it is hardly possible to set counter-actions accordingly and thus to gain control over the development of the network. This network idea was quite explicitly brought to the table by one of the citizens:

> *L6m: Now, who is standing behind and hoping or not hoping for a patent, I cannot tell. Whether it is the researcher himself, who would rejoice, whether it is the project head whose aim it is to keep his project or his group alive, whether it is the research fund, or pharma companies [...] I can't tell. But it is so obvious, doing research in an area, which is only an issue in the Western world, and which makes enormous revenue in terms of medications. And then to say: "I just wanted to know". I can very hardly imagine that. (PI, 108)*

In fluid network models there is no single clear driver - things could at any point in time develop in any direction. Governing such constellations is thus perceived as complex, and even if there were clear regulations the field is perceived as moving so fast and in so many different directions simultaneously, that any real monitoring or even anticipatory governance seems hardly possible. Innovation is thus framed in terms of chance or a coincidence of favourable conditions and much less seen as planned action:

> *[...] Concerning your statement that genome research is controlled, or is being controlled – I believe the exact opposite to be true. I think that this is a very chaotic field, and that quite a lot of research is done in parallel. [...] So, I simply believe that's like a broad mass, which moves, but which isn't oriented towards any goal, or only partially. Relevant cancer-genes are mostly found by chance. So these are chance events, you do something and have the result, and someone else has worked on that for ten years, invested much and not found anything. (L1m,RT7)*

The fluidity of these networks was often linked to implicit assumptions about knowledge as the product of and entity moving in them. To many participants it seemed unclear where knowledge might move, and for whom it might seem attractive and of relevance.

> *S7m: As soon as I start a knowledge production process, I cannot really stop it anymore and say: Okay, now there's a point in time where I condemn all people never to think in this direction again. I will not be able to that. (RT5/2/108)*

Thus in contrast to the linear model, but also to the other network models, here the basic idea is that distribution of knowledge gets woven into all elements of the societal fabric and thus there is in fact no way to "retract" knowledge.

As a response in particular to problems perceived in the second and third model, citizens argued for a more inclusionist approach, which should feature the public in a central role. They saw it as quite essential that broader societal groups and their value systems get a voice in techno-scientific developments, as these values were conceptualised as not being driven by a narrowly focused (mostly economic) logic and would

thus better represent something one could label "common interests". The following sequence brings this nicely to the point:

> *L1m: And if there is no public participation, then some powerful opinion leaders might manage to direct society in some direction. But if society is more involved in these issues, then I believe a much more balanced picture will emerge. (PI, 419)*

Giving lay-people a voice – which did not explicitly mean letting them make the decisions – or allowing for broader societal participation beyond a narrow stakeholder model, was thus expected to lead to an "enlarged innovation process". This was perceived to result in more broadly acceptable technoscientific developments. In that sense participants were referring to an ideal similar to what Nowotny et al. (2001) call "socially robust knowledge".

What does subscribing to one of these network ideas mean in terms of governing science?

Thinking in networks of innovation was often linked to a difficulty of finding a particular place or moment where citizens could/should participate. Thus, participants subscribing to a more network-oriented idea were often struggling with imagining any viable form of general governance, let alone a particular form of it. In this particular context, the pervasiveness of technoscientific knowledge was seen as a major obstacle to governance.

> *L10f: That's like setting some kind of machine in motion, and there are incredibly many gears in motion. To stop that again, that is pretty difficult or impossible. [...] Because you don't know who will acquire that knowledge, how people are going to handle it, and what is going to happen then. You can't prevent that. Except by legal restrictions. But again, those will possibly be broken. (PI, 271)*

Closely linked to the idea of lacking control over the developments, the question of who should then be held responsible was posed frequently. In fact citizens repeatedly stressed the feeling that nobody

> *... felt responsible to decide what will be done or what will not be done, [...] to take responsibility for the fact that the consequences are more or less closely related to himself. Neither have we found any kind of structure which might be the ultimate regulatory entity – be it a plebiscite, so that the people will say: we want that, or we don't. We saw, that that does not work, because there are economic interests. Be it that politicians, in which way ever, will arrive at any decision. Somehow there was no one, who would have said, it's our fault, that this is being done, or we are the ones to prevent that this will we done. But everyone pointed to someone else. And for me actually the answer is that in essence we are unable to prevent such a development. (L6m, RT7/1/202)*

But the malleability of these networks and the dynamics at work also meant that even if decisions could be taken, they can no longer be taken once for all, but need to be continuously reconsidered at different times and in different places. In one of the post-Round Table interviews, one citizen clearly exposed this tension inherent in these network models when the discussion addressed governance and responsibility:

I think that's difficult. It's difficult to attribute responsibility to a single person. But it's also dangerous to say that some central instance should take responsibility – but it has to be a multi-level process. At least that's what I think. (PI, L1m)

Contrary to the linear model, thinking in networks of innovation made concepts like up-stream or down-stream governance – which implicitly refer to a more or less concrete moment in the development – inadequate frames from which to address the complexity of the issues at stake. As suggested in the quote, they would have to be replaced by concepts capable of grasping the dynamics of a process in which negotiations over directions to choose or not to choose take place in different constellations or arenas at different moments in time. As a consequence even after a careful 'deliberation', its outcome could never be regarded as definite and binding over time.

Switching, deconstructing, reassembling and hybridising: Negotiating innovation and governance

In the preceding sections we have analytically separated the different elements and argumentative strands participants deployed in talking about innovation and governance. However, in the actual debate, participants rarely used these purified forms, nor did they consistently attach themselves to a particular model over time. Moreover, we are persuaded to understand the elements described above as a repertoire from which resources can be drawn for the purpose of positioning oneself within a given debate. The repertoire's precise use is contingent on the concrete situation and the argument to be made. Participants thus switch, deconstruct, reassemble and hybridise elements of models in multiple ways.

To get a better understanding of these dynamics, we will analyse two specific aspects of the debates. Both examples are taken from the last Round Table where participants were invited to collectively reflect on the overall experiment. The following quotes are taken from a longer sequence of exchanges in a debate around the responsibility to be taken by (basic) researchers for the knowledge they produce.

The first case could be labelled as strategic switching between models of innovation, and is intended to show how specific innovation models were important resources in pushing through one's argument and in convincing other participants. We enter the debate at a moment in time when most participants argue quite strongly - using the linear model of innovation - that basic researchers are not in a position to take responsibility for an output that is neither predictable nor under their control. In arguing this, participants employ rich variations of the following kind:

Yes, to my view, it is not the duty of basic researchers - I stress basic researchers - to see a goal, to work towards a goal. The basic researcher has to say what is out there, what do we have, and how does it look like? And how can we modify it etc. That is to my view basic research. (RT7, L9m)

This argument is framed by the idea of a linear model, which for each stage in the linear innovation chain allows to pin down the actors involved, the issues at stake and the responsibilities to be addressed. This argumentative logic then in a second step enabled participants to situate the participating scientists in the "up-stream basic

research box" and thus somehow to "protect" them from having to take any kind of responsibility for the epistemic output they produce. Many participants, who relied on these linear accounts, supported this argument.

However, the linear repertoire was just as easily hijacked by one of the other citizens to counter these statements. So far in the debates, this particular participant had mainly subscribed to a rather complex and network-oriented ideal of innovation. At this point in the discussion though, he suddenly starts 'to buy into' the linear argument deployed by other participants, by stating that "the basic researchers, whom we got to know, are not in this stage [the basic knowledge production step] anymore." One interpretation of this obvious switch might be that subscribing to linearity empowers him to construct his counter-argument, while not questioning the tacitly dominant understanding of innovation. However, while agreeing on the linearity of the chain that starts with basic research and ends in societal applications, he strongly argues to re-consider where the researchers actually are situated in this chain. Consequently he urges the other participants not to buy into the scientists' self-description as basic researchers:

> *"But the basic research, about which we are discussing here, or they have labelled themselves basic researchers, is that certain cells or enzymes in the cells make, that they become fat and others not. Maybe this is still basic research as we know little about the way fat is used in the body [...] Maybe they answer this question in their research [... But] they cannot say, that they have no idea about the outcome. They precisely know what they are looking for. And they know very well […], if I do something on fat metabolism, that at the end there will be a pill, which makes me slimmer. ... And if that was the primary aim or only a by-product or however I label it, is unimportant ..." (RT7, L6m)*

He attempts to argue that because they constantly refer to the "societal problem obesity", it is no longer possible for the researchers to retreat to the "basic research box". This is supported by another lay-member of the group, agreeing that she also thinks that the researchers are already beyond basic research, but that „they quickly retreat to their hideout [basic research]" (L5f, RT7/1/316) when it comes to discussing the consequences of the knowledge they produce. In the subsequent debate, the participants' strategy turned out successful in the sense that other more reticent participants begin to subscribe to his analysis and seem ready to move the researchers down the innovation line.

What we can learn from this, and similar interactions, is two-fold. The linear model offers a clear advantage for certain kinds of arguments, especially for clearly circumscribing the position of a certain actor in the process, and for attributing responsibility to that position. Second, using elements from innovation models is not only a strategic choice, but it also has a sense-making element, as we will see more clearly in the case outlined below.

The second case could be labelled as "struggling with innovation models in assessing potential futures". As we unfold it, we intend to show the unclear and difficult relationship between innovation models and the idea of societal learning. Here, the argument gravitates around the societal capacity to assess potential futures related to

techno-scientific innovations, and the usefulness of concepts of innovation to predict and assess these futures.

First we would like to point back to the 'fat pill' argument our 'strategic switcher' had previously made. In the quote above, he said that "in the end there will be a fat pill", and that whether this is the outcome of a deliberate linear development process or the by-product of more complex network-shaped patterns does not really matter in terms of the societal implications this product will have. He thus seems to have a strong basic trust that the research will result in an application, by whatever pathway, and he argues that in the end how the innovation has come about is only of secondary importance for discussing its implications. Hence, we may interpret him as making a useful distinction between debating about innovation and discussing potential futures and their societal and ethical implications. He strongly argues for doing the latter, which however was hardly ever done in the actual exchanges at the Round Table. This was mostly due to the pervasiveness arguments associated with the linear model of innovation: any governance of a new techno-scientific object is futile before its precise features are known.

Secondly, we may inquire how this particular participant arrives at this conclusion that "there will be a fat pill", regardless of the form of the innovation pathway leading there. Though we may only speculate in his particular case, consider another participant making a related argument in succession to the quote given above:

> *"I look at what happened in the past. We learn nothing from the past, from our history [...] I could have a look at past technologies, if something new comes up which I don't know how to handle and I could ask what is similar. And then I have a look at the societal situation. I look: what happened to the atom industry? What happened to computer and internet? These are for me previous technologies. And then I can decipher certain analogies. […] and for me there are quite some factors, which foster what happens with gene technology at the moment. For me, technological innovations and developments are put in the foreground in relation to more humanist and philosophical ones. This means, for any problem today we look for a technical solution, the others are of second order." (RT7, L4m)*

At least two messages relevant to our analysis are implicit in this quotation. The first pleads not to get captured in too much detail about how innovation precisely works, but rather to use the experiential knowledge "we" possess about past innovations and the futures, which might come along with them. He thus makes an argument that could be interpreted in the context of sociology of expectations: he uses past futures and how they have turned out in order to assess potential present futures (Brown & Michael, 2003). But simultaneously his statement may also be read as an argument that the reference to the new/unknown is not sufficient to escape from responsibility, because processes of innovation in his view are seldom without historic parallels. Society does not learn only through concrete knowledge about a specific context, but in many ways through analogy. This nicely links with one of the quotations used earlier, where the citizen stressed that scientists intuitively know where things might go to and thus should also reflect and take responsibility.

In our interpretation, the quote given above also makes a point about societal learning from history, and about the status of this learning in the debates around in-

novation. As we have observed, historic references were often used in the debates to make a point on governing innovation. However, mostly those examples arguing for positively valued applications were successful in the discussion, while the relevance of those references carrying more critical implications for potential futures was strongly contested. In commenting on the debate whether the fat pill will become reality or not, another citizen offers an interesting related comment:

> *"Somebody will surely invent the fat pill, and then it will be said somewhere that it was in Graz, that the basic research was done, and there were the first results, even if it is not done there." (RT7, L2f)*

But of course, she goes on to argue, if there will be negative outcomes and side-effects associated with the fat pill, and the innovation will fail, then all of a sudden "no one will have had anything to do with it". Her argument is that the memory about and the re-construction of past innovations is selective. Success stories are much more likely to be constructed in the first place, and they are much more likely to contain clearly delineated responsibilities then those associated with failure (or disaster). If we go beyond her statement, then we may ask how societal myths about past innovations are constructed and negotiated, and how they influence present thought about the governance of techno-scientific futures.

Discussion and Conclusion

Drawing together the many observations we accumulated during our experiment, what may be learned about the relationship between innovation and governance in a specific techno-political culture?

The most central conclusion to be reached concerns the co-production of governance and innovation. We hope to have shown how deeply entangled citizens' 'imaginations of the emergence of the new' were with ideas about the 'governance of technoscience'. In their use in the Round Table discussions, models of innovation such as the linear one implied and sustained certain idea(l)s of governance. They did so by suggesting particular moments and windows for social choice between different trajectories of innovation, or by legitimizing that certain activities, such as 'basic knowledge production', were not amenable to governance because they were out of range of 'the social'. Simultaneously, specific democratic preferences or imaginations of governance, such as on the weakness of the nation state to regulate the global flow of techno-scientific knowledge, discursively underpinned the preference of more network-oriented concepts of innovation to linear ideas.

We propose the concept of 'regimes of innovation governance' to characterize particular institutionalized assemblages of innovation models and ideas about governance within a particular techno-political culture. The way we suggest to think about 'regimes of innovation governance' is as complex translation machineries which recombine techno-scientific knowledge, artifacts, actors, institutions and governance structures to assemble techno-scientific futures. In analyzing these regimes as machineries, following Akrich (1992) we might ask for the vision of the world inscribed in them, the prescriptions they make in terms of governance, and finally how actors 'descript' them, i.e. how they use, decompose and re-assemble them.

To both illustrate this and to develop our final argument that the cultural prevalence of some of these regimes has strong democratic consequences for contemporary knowledge societies, it first seems interesting to comment on the difference between how linear and network based models are debated in academia and how they figured in our participants' discussions. In academic use, both linear and network concepts of innovation are treated as dichotomous antipodes, and most of all, as full-fledged models delivering a genuine representation of the processes at work. Thus implicitly in the academic world one would need to discursively 'buy' one of the choices as a whole. Yet in the public debate analyzed here, single elements and basic ideas of both models clearly cohabitate, they come in assemblages often ignoring the boundaries between these academic models. This also implies that a single speaker does not need to be, and hardly ever is, committed to one way of seeing innovation only. These elements are used situatively, and for different purposes, at times strategically, but very often because a different discursive framing of the discussion, or a different example referred to in the debate, seems to suggest another set of ideas of innovation to be suitable. By referring to different regimes of innovation governance, participants could strategically build their arguments. However, they could only do so within an imaginative space delimited by the repertoire of regimes of innovation governance culturally available to them.

During the debates in our experimental setting, interestingly the linear model's influence on civic imaginations of innovation was weaker than many analysts suggest. One explanation of the strong presence of network models however may also be the concrete setting in which the debates took place. Citizens and researchers were in fact engaged in a long-term interaction, in which they gradually were confronted with research and not with science – a distinction we use in the Latourian sense (1998) – thus they were afforded the opportunity to experience its entanglement with societal interests and rationales, particularly in the case of obesity. In a more short-term format, the linear models dominantly deployed by the researchers might be expected to remain more prominent. This leads us to the conclusion that different models and imaginations of innovation are not simply out there and that people come with them to any participatory exercise, but that they emerge in and get shaped by spheres and formats of public debate. This would then shed a new light on the debates around the kind of citizens participatory governance organizers might want to recruit.

Yet the struggles around regimes of innovation governance at the Round Table also point to an important paradox, which may be seen as characteristic also of many contemporary broader debates on innovation and governance. Arguments derived from the linear model of innovation could be very well used to allocate responsibility (and non-responsibility), because they conceptualize the innovation process in terms of clearly separated steps each linked to specific actors, a certain temporal moment in the process, and to a given function. At the same time, they were inextricably linked to a very object-oriented idea of governance assuming that governance could only set in as soon as the material properties of an 'object', its 'risks and benefits' were clearly discernable. Hence, in this model governance seems possible, but only for 'downstream' questions and issues. Network-oriented ideas on the other hand allowed thinking about how societal actors may influence innovation and the future shape of its products before the respective objects have been realized. Governing these processes, however, seemed hard if not impossible both because responsibility and pow-

er were seen as too dispersed and because innovation was seen as simultaneously happening in different places and under different time-regimes. Hence, paradoxically, upstream governance seemed hardly realizable in both dominant regimes, either because of tacit techno-deterministic ideas in the case of the linear model, or because of a deep uneasiness and confusion about how research densely entangled with other societal actors and logics may be governed at all in the network model.

In the introduction to this paper, we argued that given the current societal and policy preoccupations with techno-scientific innovation as a means of shaping societal futures, the question of who participates in shaping these futures is of high democratic relevance. From our observations we could argue that participants lack well-entrenched cultural regimes of innovation governance, i.e. there seems hardly any experience in thinking, conceptualizing and debating about innovation related issues, which they could relate to when discussing genomics and society. Thus up-stream governance seems hard to imagine for them in the current techno-political culture.

This opens the question of the broader cultural resources participants draw from in sketching regimes of innovation governance. Where are the places and moments at which they learn, experience or rehearse specific visions of how the 'new' emerges, how it ties into potential futures, when and what kinds of problems it might bring about and how all this is entangled with potential modes and moments of governance? In this article, we pointed at two efforts to find 'workarounds' that could be used to nevertheless address these complex issues.

The first is the use of historical examples, such as stories of Pasteur, Einstein, Darwin or Bohr, in order to underline, prove or dismiss arguments in the genome context. It is crucial to note that these historic examples constituted a discursive resource shared by virtually all participants – though the scientists were more successful in establishing an authoritative position as experts in interpreting this history. All the examples put forward were about the relation of important basic discoveries in science to societal applications of this knowledge, such as the atomic bomb in the case of Einstein or Bohr. The use of these examples framed the discussion in several ways. First, in all participants' use of historic examples, history was not thought as a succession of contingent choices, but re-constructed as a deterministic clearly understood linear pathway to the present. Hence, within these examples participants could not identify clear moments and spaces of contingency and ambiguity, a prerequisite for imagining how upstream governance of innovation might take place. Second, the examples picked assumed that the knowledge created was essential and unquestioned, and thus implied that problems would clearly rather lie in the respective applications and their context. Third, it is interesting that all these historical resources were not conceptualized as local, thus as not specific for a given context but rather as universal. This made it even more complex to use them to think in terms of local techno-cultural contingencies in ways of dealing with innovation.

The introduction of a fictional product named 'fat-pill' that stands at 'the end of the innovation chain' was the second 'workaround' citizens employed in order to grasp and discuss innovation in relation to the concrete research project and to probe possible societal impacts of the knowledge produced. That participants resort to constructing an imagined 'output object', shows that discussing innovation without referring to a concrete object/product seemed hardly possible within the cultural reper-

toire most citizen participants are bound to draw upon. Innovation was too strongly linked to producing tangible technological products - the example of Einstein and the CD player being just one of these episodes in which such imaginations are rehearsed over and over again. In talking about the properties of a concrete yet fictional object, participants, however, implicitly closed many of the upstream questions that might be asked about this particular techno-scientific trajectory. Often, the debate was tacitly framed in terms of risks and benefits connected to this object.

What are the normative implications of our analysis? Our observations lead us to the conclusion that participation exercises should not so much be simply deployed as political machines for producing citizens and consensus supportive of the implementation of certain technologies, but that it might be rewarding, rather, to conduct and analyze them as laboratories in which collective forms of experimentation and learning take place. Such an approach would allow us to better understand, and thus also publicly debate, the dominant cultural narratives which frame both citizens' and scientists' understanding of their place and their potential roles in governing innovation.

Finally, in relation to upstream engagement, our findings suggest that simple calls for classical public engagement proscribed early in the innovation process are not sufficient. Engagement should not be seen as one definite moment in the innovation process that once and for all identifies both problematic and promising pathways and defines actions to be taken. Rather it needs to be seen as a continuous process, in which academics and practitioners involved in public engagement need to collaborate with citizen and scientist participants on developing new ways of thinking about innovation and governance, many of which are sure to contradict deeply-rooted cultural assumptions held by these groups. In particular, our work here suggests that non-determinist ways of thinking about the history of science and technology combined with less object-focused approaches may open spaces for collective Gedankenexperimente on alternative ways of dealing with governance and innovation.

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