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From risk to the government of uncertainty: the case of mobile telephony

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Confronted with complex and wicked issues, public authorities turn to science and expertise to provide answers that will help reduce the level of uncertainty that characterizes these issues. Yet, the paper argues that more often than not, it is the application of a risk framework to a given issue that fosters uncertainty, not the other way round. Hence, the more authorities and experts attempt to apply a risk approach to an issue, the more they encourage the production of uncertainty. Taking mobile telephony as a case in point, the paper then goes on to show that to reduce uncertainties, authorities in some countries have recently experimented with new forms of knowledge in the process of expertise; paradoxically, this may raise in a first moment the general level of uncertainty, but it may also provide in the longer term more robust knowledge. The larger aim of the paper is to expand conceptions of uncertainty commonly used in risk governance.

Keywords: risk; uncertainty; mobile telephony

There is little agreement across the social sciences on definitions of risk and uncertainty – let alone on how these two notions relate to each other. This in turn reflects a wide range of uses across scientific disciplines, public administrations, private firms, independent regulatory agencies and civil society actors – the sum total of which contributes to numerous misunderstandings and confusion.

In what follows, risk will be understood as a quality ascribed, through a social process, to an object (Borraz 2008). This quality implies that something of human value is at stake, yet the outcome remains uncertain (Rosa 2003, 56). The important point to remember is that by framing an object as a risk, it is made governable. Furthermore, whereas traditionally the process leading to the qualification was in the hands of experts (Hilgartner 1992), it now tends to pit organizations or groups against each other: i.e. it is a contended social process.

A central element in this process is the notion of uncertainty. Beck and Giddens use the terms risk and uncertainty indistinctively to characterize the consequences of the growing pace of science and technology (Beck 1998; Giddens 1998).

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Nevertheless it is important to differentiate the two notions and to adopt a broader understanding of uncertainty encompassing both its relation to knowledge and its social dimensions. Accordingly, we will rely on the definition proposed by van Asselt: uncertainty refers to a lack of knowledge *and* the difficulty to predict future events, outcomes and consequences (van Asselt 2000). A key difference between risk and uncertainty is that, whereas the former is governable, the latter is not. To govern an object fraught with uncertainties requires the use of techniques, procedures and instruments that will convert these uncertainties into dimensions that can be acted upon.

Risk frameworks offer such techniques. We refer herein to the set of standards, protocols and guidelines that define how risk objects should be assessed, evaluated, managed, communicated and monitored. These frameworks aim at identifying and reducing uncertainties, by converting them into a risk, calling for more research or discarding them as insignificant. The process relies primarily on experts, namely scientists, who have the authority and capacity to characterize and assess uncertainties and decide whether they warrant the qualification of an object as presenting a risk or not.

However, this process has come under divergent sets of pressures on each side of the Atlantic. In the US, starting in the 1970s, large private interests (e.g. tobacco and chemical manufacturers) engaged in a highly sophisticated strategy to 'manufacture uncertainty', in order to delay or block any science-based regulation (Michaels 2008; McGarity and Wagner 2008; Oreskes and Conway 2010). They were able to suggest that on many objects being reviewed for stricter regulation, too many scientific uncertainties persisted to be able to establish a clear causal link between the object and health effects; hence, there was no sufficient ground for regulation. This strategy was developed in reaction to a regulatory process put into place during the early 1970s, with the aim of regulating risks in the environment and the workplace through the identification and reduction of uncertainties (Boudia 2009). In Europe, some 20 years later, the picture is different. The growth of uncertainty in this case is directly linked to the multiplication of controversies surrounding new technologies; a key argument of opponents to genetically modified organisms (GMOs) or mobile telephony, for example, being that the breadth of the uncertainties justifies that these technologies be considered as a risk and consequently governed under the precautionary principle (Borraz 2008). Hence, while on one side of the ocean the manufacture of uncertainty serves to avoid regulating an object as a risk, on the other, it is precisely because an object is fraught with uncertainties that it qualifies as a risk and calls for political action. In both cases, only if an object has been defined as a risk can it be governed.

What this implies is the need to pay more attention to the role of uncertainty in risk regulation. More precisely, the situation on both sides of the Atlantic suggests that the production of uncertainty can only be understood in relation to the procedures designed to analyse and regulate risks (which they have often later contributed to reform). Hence, in this paper, we wish to give a more precise account of the way in which applying a risk framework to a new technology in Europe actually increased the level of uncertainty and triggered a controversy. We will then show that experts and government officials have begun to acknowledge these unintended effects of risk regulation procedures, and experimented with alternative modes of dealing with the knowledge and uncertainties pertaining to new, controversial technologies. This in turn suggests that we may be in the midst of a shift in

the governance of new technologies, one that recognizes the necessity to include a wider range of evidence and to engage with a larger set of stakeholders and scientific disciplines. We will conclude that by acknowledging the existence of multiple uncertainties, governments will in the end be led to recognize their inherently social and political nature.

We will use the case of mobile telephony as an illustration. As an issue, it has been on the agenda of European governments, the European Union (EU) and the World Health Organization (WHO) for over a decade now. Countless expert reports have come out, followed by numerous governmental action plans, without the problem showing any sign of phasing-out. Indeed, as governments have actively sought a solution to this issue, they have turned it into a 'wicked problem' (Rittel and Webber 1973). More recently, along with GMO, mobile telephony has become a 'testing ground' for the development of new forms of governance.

This paper rests on extensive research on controversies over mobile phone antennas in France, combined with research on the regulation of mobile phone risks in five European countries: Belgium, France, Spain, Switzerland and the UK (Borraz and Salomon 2007, 2009; Borraz 2008). It also relies on existing literature on the topic, participation in various committees and several encounters with French and international bodies in charge of regulating this issue.

Risk and uncertainty in mobile telephony

The issue of mobile telephony arrived on the agenda of European governments and the Commission in the late 1990s–early 2000s. Whereas in the US the controversy focused on the handsets, in Europe the antennas were and remain the major source of concern. The issue was spurred by local protest against existing sites or projected constructions of mobile phone antennas for a variety of reasons including aesthetic concerns, loss of property value, threats to civil liberties, or lack of public consultation on the siting of antennas (Burgess 2004).

Nevertheless, rather than consider that protest movements against a handful of antennas (vs. the tens of thousands being rolled out) were 'normal' and predictable, the European Commission and governments across Europe interpreted these protests as a potential source of crisis. Mobile phone operators followed closely in step. Several reasons can account for these actors' perception of mobile telephony as an issue, including: the fact that mobile telephony had aroused media interest following a lawsuit in the US against mobile phone makers, on the grounds that the handsets could present a risk of brain tumours[1]; the risks related to mobile telephony (handsets and antennas alike) echoed ongoing debates over the risks of high voltage power lines (and childhood leukaemia, in particular); the issue arose in a wider context of increased concern for environmental health risks, following recent crises (mad cow, asbestos, food safety, GMO); parliaments were eagerly picking up this issue to show their concern for protecting the health of citizens against government officials accused of siding too often with powerful economic interests. For all these reasons, the issue was quickly identified as a potential source of contention – one which could furthermore hinder the development of mobile telephony at a time when this technology was encountering an unprecedented success and benefited from strong support from the European Commission and national governments.

This triggered an uninterrupted series of expert reports, conferences and publications, from European institutions, member states and WHO during the next ten

years. Regulatory measures, research programmes and intensive media coverage followed. However, far from removing the issue from the agenda, its position as a health priority for public officials was reinforced. How can this be accounted for?

Almost from the beginning, the issue was framed as a potential health risk – rather than as an environmental, planning or even aesthetic problem. In a context of health scandals and crises, public officials singled out the potential health risks of mobile telephony and undertook to address them separately from the rest of the issue. Yet, this initial framing was misleading as many protest movements did not start out by focusing on health – indeed in many cases, this was simply not a concern (Burgess 2004). However, as the problem was framed as a health issue, opponents to antennas were encouraged to work with alternative experts and activists engaged in struggles against the risks of electromagnetic fields. The latter argued that there was a sound basis for considering that there existed a health risk, and that furthermore, it would be a mistake for governments, following the mishandlings of the mad cow and asbestos scandals, to neglect the data suggesting such possible harm to health. Faced with what was now turning into a major controversy, public authorities turned to scientific experts to reinforce their evidence base.

The majority of expert reports concluded that, whereas the handsets could theoretically pose a health risk, antennas presented no risks whatsoever: i.e. not only was the existence of a risk not established, given the state of the science, but it was also theoretically implausible given the low levels of emissions produced by antennas often operating far away from individuals (either from masts or rooftops). These reports were immediately contested by activists and counter-experts on the grounds that they: relied on scant scientific evidence; refused to take into account studies undertaken by 'independent' scientists that, whilst not published in scientific journals, pointed to the existence of health risks; neglected evidence of all sorts provided by alternative experts, activist movements and local protesters that mobile phone antennas produced health effects amongst neighbouring populations. Yet, official experts preferred to focus on peer-reviewed results published in scientific journals to establish their assessment, thus shedding light on just a small portion of the issue at hand. In so doing, they fuelled the controversy as it was easy for opponents to suggest that conflicts of interests were behind this choice to limit the analysis to a small number of studies. In the case of mobile telephony, the small number of experts on this topic and the fact that many had worked on projects financed by private operators facilitated this critique. Hence, the more expert reports undertook to close the controversy, the more they fuelled alternative reports and contestation that resulted in the widespread perception of a very uncertain technology.

Meanwhile, many of the factors that partook in the emergence of mobile telephony as a risk were simply discarded by expert committees, on the grounds that they could not be assessed scientifically. These factors referred in particular to the behaviour of the different actors in the rollout schemes (e.g. private operators, construction companies, local and state officials, property owners), the causes of local protests, or the characteristics of the places in which mobilizations occurred (Calvez 2011). They were not processed in the risk assessment framework because they were not judged to be scientific issues and because social scientists capable of assessing these factors were not in the expert committees. Accordingly, local protest movements kept multiplying at a steady pace, in some countries strongly hindering the deployment of mobile telephone networks (e.g. Spain). And health became a

central concern of many of these movements, as it represented a decisive argument in getting attention from public officials.

Furthermore, the controversies also revealed divergent values, ideas and worldviews. Again, the expert groups, who had no capacity to assess the benefits of the issues being discussed, could not address these and focused on the (potential) risks as if they were disconnected from the outside world. In the case of mobile telephony, few, if any, of the expert reports tried to assess the benefits of this new technology, apart from some vague and general statements; let alone discuss the opportunity of putting such a technology on the market and developing new uses at a rapid pace. This gave activist movements the possibility to link the issue to wider debates on the governance of new technologies or the role of science in modern society, or to hook up to other issues such as GMO, in so doing mustering further support for their cause.

To sum up, efforts by public administrations to apply a risk framework to the issue at hand amplified the controversies and turned the issue into a wicked problem. As Rittel and Webber observe, a wicked problem is ill-defined, ambiguous and associated with strong moral, political and professional issues; it is stakeholder dependent, i.e. there is often little consensus on what the problem is, let alone how to resolve it; it will not keep still: it is a set of complex, interacting issues evolving in a dynamic social context; finally, new forms of wicked problems emerge *as a result* of trying to understand and solve one of them (Rittel and Webber 1973, 160–7). This is precisely the case with mobile telephony.

More importantly, although countries have adopted diverging positions, some following the EU recommendation[2] and ICNIRP[3] levels of exposure (e.g. UK, France, Spain), others adopting lower 'precautionary' standards (e.g. Belgium, Switzerland, Italy), this has had little impact, not only on the overall controversy but also on the situation within these countries. In all these cases, a strictly scientific approach fuelled a controversy over the uncertainties left out.

Hence, public authorities in many countries have come to realize that this issue would not disappear in the near future from their agenda. The same acknowledgement applied to GMO. Public authorities understood that to govern these objects and their potential risks implied learning to live with these risk issues and the continuing controversies surrounding them.

Bridging the gap between risk and uncertainty: a pluralist approach

Almost from the beginning, as the controversy unfolded, public officials and experts turned to social scientists specialized in the study of risk perceptions and risk communication in order to better understand popular representations and to develop more effective communication schemes. For the most part, these produced limited and disappointing results. Nonetheless, national governments, the European Commission and WHO remained (and often still remain) steadfast in their pursuit of a communication strategy capable of settling the controversy.

Alongside these efforts, initiatives surfaced in various countries (namely France, Belgium, the UK, Sweden and Switzerland) that mark an attempt to address the multiple uncertainties mentioned earlier. These initiatives do not partake in the production of an integrated approach, but rather remain dispersed. By bringing them together, we wish to suggest that they contribute to a renewed understanding of risk issues. These initiatives cover three dimensions: (1) the types of knowledge used;

(2) who should provide the knowledge; (3) the scientific and political procedures processing this knowledge.

Types of knowledge

Given the multiple uncertainties around emerging risks, it may be important to gather as much information as possible from as many different sources as possible, in order to get a clearer idea of the problem. This implies acknowledging the fact that scientific evidence, and more precisely, peer-reviewed results, offer only a limited understanding of the many unknowns, let alone all the other factors that account for the qualification of the issue as a risk. Thus, the UK independent expert group on mobile telephony in 2000 makes the following recommendation:

> We recommend that in a rapidly emerging field such as mobile phone technology where there is little peer-reviewed evidence on which to base advice, the totality of the information available, including non-peer-reviewed data and anecdotal evidence, be taken into account when advice is proffered.[4]

The fact that the Stewart committee, as it is better known, advocated the need to take into account a large range of evidence stemmed directly from the mishandling of the BSE crisis by the British government: the Stewart report came out during the inquiry by Lord Phillips and William Stewart himself had been chief scientific officer during the period of the BSE crisis. He was careful to avoid prior mistakes and notably an excessive reliance on mainstream science alone in the face of multiple uncertainties (Stilgoe 2004).

These additional types of knowledge fall under three general categories.

The first category is made up of non peer-reviewed studies. The community of experts does not consider these studies to be scientific, as they have not been through a process of validation or replication (or have failed to meet their standards). Nevertheless, these studies rely on scientific methods to suggest the existence of possible risks. In the case of mobile telephony, this covers a wide range of reports that have come out over the years. Some expert groups, for example, in Switzerland (Krueger report in 1998) and the UK (Stewart report in 2000), have taken their results into consideration to provide an overall assessment. In the Swiss case, this was encouraged by the 1983 law on environmental protection, which states that all potential sources of nuisance should be reduced to as low as (technically and economically) feasible; accordingly, any evidence suggesting a nuisance is a legitimate motive for reduction. However, in most other cases, scientific experts, careful to provide an advice based solely on valid science, systematically discarded these 'non-scientific' studies. Yet, given on the one hand their potentially high media impact (their authors suggesting that their results run counter to other studies financed by industry, and that this is the reason why they were not published or reproduced), and on the other the growing awareness of the many remaining unknowns (notably on non-thermal effects of radiofrequencies), some expert groups were pressured into paying more attention to these studies. Thus, several groups or committees commissioned on mobile telephony in Germany, the Netherlands or France decided to take into consideration (even if to produce a negative evaluation) the controversial 2007 BioInitiative report.[5] In a similar vein, a 2009 report by the French environmental health safety agency acknowledged a set of 'isolated' studies

that signalled potential health effects.[6] A majority of the French expert group considered that these studies did not invalidate the general conclusion that mobile phone antennas presented no risks; but a minority thought otherwise and suggested a more precautious wording. The head of the agency, when writing up the advice to the government, sided with the latter and concluded that these studies revealed uncertainties that had not been properly recognized before, and accordingly justified applying the ALARA (as low as reasonably achievable) principle.

The second category of knowledge comprises social and economic sciences. These can be used, in particular, to assess the benefits of a technology. For the moment, Europe and its member states stand in contrast with the US, where cost–benefit analysis was introduced in the late 1970s–early 1980s to supplement risk analysis. The situation is slowly changing, with the REACH (Registration, Evaluation, Authorisation and Restriction of Chemical substances) directive providing for a socio-economic analysis,[7] and initiatives regarding GMO in the UK (*GM Nation?*) and France (High authority on biotechnologies). However, even in the case of mobile telephony, a progressive shift towards social and economic sciences can be witnessed, in research programmes, scientific committees and expert groups. Initially, social sciences were ushered in to provide insights into the public's risk perceptions, and advice on risk acceptability and risk communication (e.g. the UK and Spain). However, it quickly appeared that risk perception, far from being a driver of the issue, was a result of the way in which the issue had been handled, in particular due to lack of trust in experts and public authorities. Hence, it became necessary to probe deeper into the mechanisms that could explain the emergence of the issue. The French environmental health safety agency recognized the need to involve social sciences in the expert process, in order to achieve a better understanding of the controversy around mobile telephony. The French Health and Radiofrequencies Foundation and the British Mobile Telecommunications and Health Research programme (MTHR) also recognized the need to provide more social science input, in particular on the modalities and motives of protest against antennas.

The third type of knowledge is the most controversial. It covers practical knowledge, individual experience, 'lay knowledge' (Wynne 1996) and 'anecdotal evidence' (Moore and Stilgoe 2009). These are forms of knowledge that are not considered legitimate by scientists or public authorities, but are often deemed trustworthy by lay individuals – and can in some cases provide new insights that scientists may have overlooked. In the case of mobile telephony, the Stewart report in 2000 decided to take into consideration, alongside scientific studies, individual experiences provided by letters and accounts voiced during public meetings. The introduction of such 'anecdotal evidence', along with other sources of data (including a media survey), led the expert group to consider that many uncertainties remained around the issue, calling for a precautionary approach (Stilgoe 2004). It also led to a research programme (MTHR) that took into account anecdotal evidence to define new research priorities.

These three broad types of knowledge constitute a major challenge to expert procedures whose primary objective is to reduce uncertainties, since in most cases they produce new uncertainties. However, this is necessary in order to explore the limits of the known and unknown unknowns. In so doing, they also contribute to a redefinition of the boundaries between what is scientific and what is not scientific (Moore and Stilgoe 2009). This redefinition is highly contested, between those who argue in favour of 'sound science', i.e. a closed and traditional approach to the pro-

duction of scientific knowledge, and those who press for a more open process, bringing in different types of knowledge and knowledge carriers (Callon, Lascoumes, and Barthe 2009). In the UK, for instance, the Stewart report embarrassed the ministries of health and industry that decided not to follow the precautionary approach advocated by the report. They asked the Advisory Group on Non-Ionising Radiation (AGNIR) of the National Radiation Protection Board (NRPB) for an update of the Stewart report: relying solely on strict scientific data, AGNIR stated that mobile phone antennas presented no risk and that the UK should adopt the ICNIRP and EU standards (something it had done a few years before already).[8] In an unparalleled move, William Stewart, who in the meantime had become chair of the board of NRPB, produced his own report in which he repeated the conclusions of his 2000 report and denounced the lack of appropriate measures by the government and, indirectly, the limited scientific position adopted by the NRPB experts.[9] He also argued in favour of a risk evaluation integrating scientific and socio-economic data.

Providers of knowledge

Each category of knowledge calls for a specific type of actor to provide input.

Regarding the first category, alongside scientists, the providers of knowledge can be alternative experts, 'outsiders' or 'outcasts' of the scientific community. On mobile telephony, alternative experts were never a part of an expert group, but some were auditioned. An interesting exception is Belgium, where a well-known 'counter-expert',[10] who had openly spoken out against the risks of radiofrequencies, was asked to write a report alongside two other experts: public authorities wanted to demonstrate their openness in the aftermath of several food scandals that had shed doubts on the credibility of experts. Not surprisingly, the three individual reports arrived at different conclusions. This led the government to consider that, given the uncertainties (as illustrated by the disagreements between experts), it was necessary to apply the precautionary principle. Elsewhere, activists organized shadow expert groups that produced reports challenging the official reports, both on their lack of independence and their use of peer-reviewed data only (the BioInitiative report being the most famous). In turn, some public authorities and courts (e.g. in France in early 2009) were led to consider that the existence of diverging reports (whatever their origin and authors) implied the persistence of uncertainties, hence justified applying the precautionary principle.

The second category comprises sociologists, political scientists, economists, lawyers or psychologists. In general, they are auditioned, eventually asked to carry risk perception studies, but rarely invited to be experts. One reason for this is that social scientists are suspected of representing the objects they study: economists are accused of bringing in economic interests in expert groups; sociologists of defending the positions of social movements or victim organizations. Nonetheless, some social scientists have recently joined expert groups: in France, a political scientist, a psychologist and a psycho-sociologist joined the expert group on mobile telephony in the French environmental health safety agency (Afsset) in 2009. However, when they do join expert committees, the expectations they foster can be quite diverse: from providing knowledge on the social dynamics of risk issues, to explaining risk perceptions, providing insights on risk communication and acceptability, suggesting psychological explanations to people's fears, analysing the policy process, or talking on behalf of the interested parties! These multiple demands reveal the need to

define more precisely the exact nature of the knowledge provided and to shape the other experts' expectations of what social sciences can actually provide.

The third category is potentially the largest. It is made up of NGOs, individuals, patient organizations, or professional organizations. These players can be collective or individual, representing a cause or simply experts in a given field, acting on behalf of their own interests or for a larger cause. The Stewart committee in the UK thus included two lay members, who had no specific knowledge of the issue being discussed. The latest Afsset expert group on mobile telephony allowed one NGO representative to sit in and listen to the discussions between experts – with opportunities for voicing his own concerns and questions, but with no say on the final report. In general, the 'interested parties' are auditioned. However, there is a growing recognition that they must be involved in the process, if public authorities want to ensure that the outcome receives wider support. For instance, the French Health and Radiofrequencies Foundation organized regular meetings with activists in order to discuss research priorities, the programme of its annual conference, and the selection of research projects. This slowly led to the recognition that these actors were legitimate in addressing their questions to researchers.

All these actors have different interests, values and worldviews. Hence, bringing them together, for instance in a committee, produces conflicts and tensions, in other words more uncertainty, at least in the initial stages. Expert procedures have rarely been designed to include such actors; they are adapted to scientists who have already accepted the procedures' constraints and role definitions. Indeed, the selection process aims at recruiting experts who not only present all the necessary credentials, but also can be expected to behave according to the rules, both implicit and explicit, of the expert body. The three categories of actors mentioned above fall outside these criteria, at least initially, and this creates tensions that bring into question not only the procedures used to recruit experts but also the rules that govern the expert group.

Procedures

The production of knowledge and recommendations on risk issues requires a set of procedures, rules, and institutions that provide legitimacy to the process. These are both scientific and democratic, as illustrated by some recent experimentation.

Scientific procedures define how expertise should be organized so that its claims will be seen as legitimate by authorities and the public. The questions that must be addressed herein concern not only the types of knowledge and actors that should be involved in the production of expertise, but also the manner in which they should be involved. What is at stake is the definition of 'a new body of standards of proof, correctness, truth and agreement in science' (Beck 1998), that gives more weight in particular to uncertainties than established facts.

This can be illustrated by the decision by the French environmental health safety agency not to follow the majority of experts' conclusions on mobile telephony and to consider, along with a minority of experts, that a limited number of studies pointing at a potential health hazard justified the use of a precautionary approach. This triggered a controversy with the larger scientific community, as it was perceived as giving more weight to a limited number of studies, which moreover were not considered entirely rigorous, against a larger number of validated scientific studies. However, this advice needs to be set within a new frame of reference: by adopting

the ALARA principle, the head of the agency was able to give more weight to some, even inconclusive evidence, against the bulk of available knowledge: even when the risk is not demonstrated, reducing emissions to lower, economically acceptable and technically feasible levels of exposure, was presented as a legitimate move. This suggests that new scientific procedures may be needed to address emerging risks, procedures that encapsulate political choices and values, and give more weight to the uncertainties when analysing new technologies.

Democratic procedures define how policymakers will use scientific advice. With emerging risks, they face two challenges.

The first deals with closure. On GMO and radiofrequencies, public authorities have come to realize that these issues would not disappear. Hence, they need to organize decision-making procedures that do not aim for closure, but maintain the controversy open but stabilized. One way to achieve this is to provide institutional form to 'dialogical engagement' and to invent institutions 'which allow us to monitor technological change' (Giddens 1998). Another is to invent procedures that allow for the reversibility of decisions (Callon, Lascoumes, and Barthe 2009). This does not imply that some form of closure will not be achieved; it suggests that the possibility to revise decisions according to new evidence, for instance, be acknowledged and institutionalized from the beginning (Wynne 2001).

The second challenge concerns uncertainty. The entire decision-making process is focused on reducing uncertainties in order to provide a viable solution. Yet, on emerging risks, the uncertainties are too numerous and moreover diverse for this goal to be achieved, at least initially. Furthermore, in most cases, these uncertainties are not easily reducible, but on the contrary, call for different methods of deliberation, knowledge production and stakeholder engagement. All this implies that previously depoliticized areas of decision-making become politicized (Beck 1998). In other words, uncertainties must be initially acknowledged in their diversity before undertaking a process of reduction.

In the case of mobile telephony, two recent examples highlight these challenges.

The first initiative took place in Sweden. Between 2004 and 2005, a 'Transparency forum for mobile phone communication' brought together stakeholders in small workshops, with an open-ended mandate and the objective of facilitating mutual understanding between the different protagonists (Lezaun and Soneryd 2007). In the course of the meetings, they learned to know each other better, showed signs of mutual respect for each other's position (even if they disapproved of them), and began discussing technical issues. An evaluation of the initiative in 2006 suggests that, on the basis of positive results on individual participants who learned to engage in a dialogue over a contentious issue, the Swedish radiation protection authority (SSI) should create a more permanent forum for continued dialogue. Yet, if the initiative proved fruitful in bringing together the different stakeholders, it does not seem to have had any effective impact on the decision-making process, at least for the time being. This is in part due to the fact that SSI did 'not seem particularly willing to be itself moved by the process of consultation' (Lezaun and Soneryd 2007, 292).

The second example, in France, presents some similarities, yet could achieve different results. The Roundtable on radiofrequencies and health started out in piecemeal fashion. Created at the beginning of 2009 in the aftermath of several court decisions that required mobile phone operators to take down their antennas, the initiative was expected to come rapidly to a solution in order to avoid all

50,000 antennas becoming a source of litigation. The roundtable comprised representatives of all the potential stakeholders, members of the different ministries and public agencies, elected officials and 'qualified persons' (two sociologists and a legal scholar) – but no scientists. It met on a regular basis with no clear rules, a vague list of subjects to cover, no specific procedures. The meetings were chaired in a very loose fashion, the president letting each participant voice his opinion or concerns, but carefully avoiding any debate. In June 2009, the roundtable came up with series proposals to create several specific subcommittees. After the summer, the roundtable began meeting again. It became clear that the different participants were actually eager to continue discussing, not the science, but other aspects related to mobile telephony (roll-out of antennas, measures of exposure, information to the public, research priorities), in other words to 'monitor technological change'. The question remains as to what the government will and can actually do with the work produced by the roundtable and its subcommittees. But one can expect that, as some forms of consensus arise on certain topics, it will be hard for the government not to take these into account.

What is interesting in both cases is that authorities chose to recruit stakeholders rather than representatives of the general public; in other words, actors already involved, knowledgeable and with clearly defined interests, rather than lay citizens with no clear ideas, let alone positions (this was the case, on the other hand, with GMO and nanotechnologies in France and the UK, with limited success). These actors, during the course of the discussions, learned to interact with each other. Far from reaching any sort of consensus, this simply made it easier for the different parties to get to know each other, anticipate their behaviours and responses, in other words become less unpredictable. In turn, this made it possible for them to interact on specific topics, such as measurement instruments and campaigns, something that had been hitherto impossible.

Both experiences provided the different actors with an opportunity to explore the different uncertainties related to mobile telephony. The question remains open whether or not this will lead to decisions and whether or not these will provide for some sort of reversibility in the future, should new evidence surface. But the French initiative seems headed in this direction, with the roundtable and its subgroups meeting on a regular basis, while the new National health safety agency (Anses), a merger of Afsset and the Food safety agency in 2010, is setting up both a permanent working group on radiofrequencies, whose tasks will be to revise annually the state of the science and to monitor new evidence provided by research, and a committee of stakeholders charged with providing input in the research process (a continuation of the one created by the French Health and Radiofrequencies Foundation, now a part of Anses).

Conclusion

Three general conclusions can be drawn from the preceding discussion.

First, the success of a general discourse on risk, or what has been referred to as 'risk colonization' (Rothstein, Huber, and Gaskell 2006), cannot be explained by the fact that public problems today are more uncertain than before. Rather, the reverse claim can be made: as risk has become an 'organizing concept' (ibid.), it has fostered the idea that officials today face problems that are more complex and uncertain. This paradox can be understood using the case of mobile telephony: it is

not so much the initial uncertainties that warranted the use of a risk framework, rather it is the use of such a framework that helped produce, reveal or amplify numerous uncertainties; in turn, these called for the adoption of more risk instruments. Hence, risk and uncertainty mutually reinforce each other. As risk spreads throughout public administrations, both as an organizing concept and as a way of framing a variety of issues, this reveals uncertainties that actors were not initially aware of; in turn, these uncertainties justify adopting risk instruments in order to provide guidelines for decision-makers; this leads to the recognition of further uncertainties, for example relating to the decision-makers' reputation; these institutional risks become potential sources of additional uncertainties; etc.

Second, the driver behind this self-perpetuating dynamics is the gap between the risk instruments used to address issues, and the multiple uncertainties that have contributed to put and sustain these issues on the agenda. In particular, the adoption of techniques that seek to reduce uncertainties has fuelled ongoing controversies. The more governments and experts put forward 'purified' (i.e. unbiased) techniques destined to produce robust scientific advice, the more they produce, reveal or amplify additional uncertainties that are used by the different protagonists to keep the issue alive. This cannot be explained solely by a lack of trust in experts and government officials; rather we must analyse the nature of the evidence that is used and how it relates to wider debates.

Third, reducing this gap has been a major concern for governments. We discussed the development of more pluralist approaches to expertise in the field of health and environmental risks; where pluralism concerns the types of knowledge, the providers of knowledge and the procedures that are used to produce the evidence. An assessment of the impact of these pluralist approaches in the field of mobile telephony suggests that they can provide more robust evidence to policymakers, in particular since they do not deny the political nature of the issues at hand. Yet it is still too early to tell if the different initiatives mentioned above will have a deeper impact – or if they will simply contribute to a dispersion and dilution of institutional risks. They may very well remain 'talking shop' initiatives, situated on the margins of decision-making procedures, and designed to attract attention, keep the opponents busy and to demonstrate the authorities' desire to engage in dialogical forms of governance. Yet, this presupposes that the stakeholders engaged in these initiatives are either naïve or simply interested in being offered a stool in the policymaking process: experience shows that this is not the case, and that they have learned to use the media and the courts to state their claims and become active players.

Two other elements, meanwhile, suggest deeper forms of resistance. First, these evolutions imply a transformation in national styles of policymaking, institutional arrangements and even 'civic epistemologies' (Jasanoff 2005), in particular regarding what is considered an 'acceptable' scientific argument in the policymaking process. In other words, the problem is not so much the integration of the knowledge produced by these initiatives in the decision-making process, than their acceptance by wider audiences as legitimate statements and claims. These audiences include the public, courts, the media and academia. Second, policymakers and the public need to invest time and energy in solving issues that may not be considered priorities in terms of health or the environment. Many would argue that public authorities should establish clear priorities and invest time and energy only in the 'real' problems. Yet this would miss a key point, which is that risk problems are always more

than just about health or environmental risks. And it is precisely by addressing their different uncertainties that these wicked problems can be redefined into more proper terms, i.e. social issues with a strong health or environmental dimension.

Notes

1. Ultimately the plaintiff lost, on the grounds that there was not enough scientific evidence to suggest a causal link. But the lawsuit spurred the mobile phone manufacturers into financing a large research programme to investigate potential health effects between 1993 and 1999. This indirectly amplified the controversy, as the head of the programme went public in 1999, stating that some of the results suggested a possible link between the handsets and brain tumours. Immediately removed from the programme, he became one of the more outspoken whistleblowers of a health risk linked to mobile telephony.
2. Recommendation of the European Union Council on limiting exposure of the general public to electromagnetic fields, 12 July 1999.
3. International Commission on Non-Ionising Radiation Protection.
4. Independent expert group on mobile phones, *Mobile phones and health*, 2000, p. 25.
5. BioInitiative Working Group, *BioInitiative Report: A rationale for a biologically-based public exposure standard for electromagnetic fields (ELF and RF)*, D. Carpenter and C. Sage (eds.), 2007. The report, published on the Internet, is a collection of articles, with a conclusion and set of recommendations by the two editors. Its aim is to reduce the exposure levels below existing international standards.
6. *Les radiofréquences. Mise à jour de l'expertise relative aux radiofréquences*, Afsset, 2009.
7. Within the European Chemical Agency (ECHA), socio-economic analysis is expected to play an important role in the authorization and restriction processes.
8. Health effects from radiofrequency electromagnetic fields, *Report of an independent advisory group on non-ionising radiation, NRPB*, 14(2), 2003.
9. Mobile phones and health 2004, *Report by the board of NRPB, NRPB*, 15(5), 2004.
10. Jean-Marie Danze had previously worked on the health effects of high voltage power-lines and was close to the Belgian NGO Teslabel active against different sources of electromagnetic pollution.

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