Matthias Gross
Harald Heinrichs
Editors

Environmental Sociology

European Perspectives and Interdisciplinary Challenges

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Chapter 1
Introduction: New Trends and Interdisciplinary Challenges in Environmental Sociology

Harald Heinrichs and Matthias Gross

Abstract This introductory chapter discusses the general development of sociological thinking as regards its conceptualizations of nature and its potential to deliver knowledge in inter- and transdisciplinary research. The chapter starts with an overview on sociology's attempts at theorizing society as part but also as opposing the natural world. Recent debates in complexity theory and ecology have fostered debates among sociologists to open the discipline to more inter- and transdisciplinary approaches. The fields discussed in the chapter include arguments for sociology to include concepts such as environmental flows, sustainability, new policies towards adaptation to changing ecological realities as well as social experimentation.

Keywords Environmental social science • Adaptation • Ecological restoration • Environmental reform • Global environmental change

Sociology and the Balance of Nature

Sociological questioning pertaining to the role of nature in society is as old as the discipline of sociology itself. For most classical authors, modern society remained in a dual relation with nature; society remains incorporated into nature and yet it stands opposed to it. In this view, nature is opposed to everything which is called human, to what is artificially worked and produced, to everything which is defining of society. In early twentieth-century sociology the notion of nature was carrying at

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least two different meanings, one referring to inner nature, which often meant an early stage in the development of a person, the other is the “outer nature,” that is, the all-inclusive complex of the material world outside of human groups and societies. In social theory, all these meanings have been used in reference to society. For classical sociologist Georg Simmel, for instance, the “whole history of mankind is a gradual rise of the spirit to mastery over the nature which it finds outside, but in a certain sense also within, itself” (Simmel 1958 [1911]: 379). Especially with the rise of new environmental movements since the late 1960s, the term nature in sociological writings has normally been used synonymous with ecosystem or in connection with the degradation of ecosystems.

In most of nineteenth-century social thought the impact of nature on society was perceived as determining. Social thinkers of the time were driven by the view that environments shape culture; that is, not only that geographical factors determine cultural characteristics, but also that these factors directly act on cultures. This geographical or environmental determinism addressed questions of how cultural features originate, change, adapt, and function. This view made it possible to explain all cultural features and accounts for cultural diversity by reference to influences of the natural environment. Thus the primary ecological issue for some late–nineteenth-century thinkers with regard to the material environment was less the origins of environmental degradation and environmental problems, but how societies are held in check by their natural environment.

An official sub-discipline of “environmental sociology,” however, emerged only after the appearance of what has been generally labeled “public environmental consciousness” in North America in the 1970s. Environmental sociology sought to theorize the connection between human societies and the natural environment, but with a clear understanding that one-dimensional environmental determinist descriptions of society do not help in our understanding of environmental problems and disasters. In response to these public concerns, a separate section devoted to environmental sociology was founded by the *American Sociological Association* in 1976. Now the main focus shifted from “naturally given” effects on social development to the human transformations of the natural environment on human societies (human induced global climate change, the smell of mountains of waste, contaminated industrial sites etc.) that can very well act back on human societies. Since its beginnings, environmental sociology has thus placed emphasis on studying the dependency of social life and cultural development from its natural surroundings, and on those factors that cause environmental problems and efforts to solve these problems. The first prominent formulation of the field can be traced to a series of influential articles by Riley Dunlap and William Catton (e.g., Catton and Dunlap 1978; Dunlap and Catton 1979). In these, Catton and Dunlap asserted their view that environmental sociology was a discipline-reshaping force of considerable importance. Their work also carried the implication that the theoretical divisions and concerns of sociology up to the 1960s and 1970s were beside the point. In other words, environmental sociology of the 1970s was consciously fashioned as a critique of mainstream sociology. Although Catton and Dunlap did not intend it (Dunlap 2002), their early writings were often understood as targeted against the classical tradition that ‘‘has been inhospitable to the nurturing of ecologically-informed sociological theory and research’’ (Buttel 1986: 338).

However, despite the early calls for a *New Ecological Paradigm* (NEP) via the writings of Catton and Dunlap, which should challenge the alleged anthropocentrism of classical sociology by including environmental forces as objective variables in social explanations, in the following years the notion of a *New Ecological Paradigm* instead has become a widely used measure of pro-environmental orientation in sociology and other disciplines (see e.g., Dunlap and van Liere 1978; Stern et al. 1995). Today, the so called NEP-scale is a most frequently used measure of environmental concern. In this vein, environmental sociology from the late 1970s to the early 1990s focused on environmental attitudes and behavior in order to understand differences by reference to class, sex, age, income, or education. In this branch of sociology the visions of nature were reconstructed and explained in terms of cultural background, social position, or economic interests, that is, of social constructions of nature. Despite being a relatively young sub-discipline, environmental sociology in the tradition of Dunlap and Catton has produced a wide array of theoretical and empirical studies. There are, for example, studies on environmental awareness, sustainable consumption, ecological modernization, social movements, environmental justice, environmental communication, as well as numerous attempts at developing different social theories on society and its natural environment. Contrary to many fields of ecological practice and the self description of ecologists, in public, as well as streams of environmental sociology, nature alone was implicitly regarded as being in ‘natural’ balance and not depending on human action. Consider the sociological approach of static nature. With many environmental sociologists to this date as well some streams of the classic tradition, it has always been the idea of a steady state or fixed equilibrium of nature. At the end of the nineteenth century Emile Durkheim was quite explicit: “As for the physical world, since the beginning of history it has remained sensibly the same, at least if one does not take account of novel ties which are of social origin” (Durkheim 1933: 348). In other words, sociologists could easily bracket out any outside powers of nature as an explanatory variable for social developments. Quite rightly, this was the major criticism of many environmental sociologists such as Catton and Dunlap and their call to overcome some of the classical notions of sociology (cf. Rosa and Richter 2008). Obviously, changes in nature itself and the ways how these changes might potentially act on social constructions have not been considered for a long time. This is no coincidence. Although the discipline of ecology has undergone a conceptual shift from an emphasis on ecosystem stability and balance to an acknowledgement of the importance of flux, chaos, and change in the natural world, this change – although accepted with profound implications in ecological restoration and conservation management – has not reached the general media or even much of social scientific literature (Gross 2003; Ladle and Gillson 2009). Indeed, many sociologists still – at least implicitly – portray the aim of the environmental sciences, ecology, and of conservation efforts as being one of maintaining natural stability, harmony and some type of natural balance. Especially the ideal of a balance of nature is still relevant for contemporary environmental thinking. Indeed, for the most part it was a prerequisite for how environmental problems were to be defined, and how their solution should be envisaged. The idea of a balance in nature, so to speak, was seen not as human desire, but as a necessity imposed by nature. Thus environmentalism in the 1970s seemed to be a radical movement, but the ideas on which it was based represented a resurgence of early-twentieth-century ecology blended with romantic myths about nature (see e.g. the musings of deep ecologists to the current date). In this view undisturbed nature always achieves a balance, constancy, stability, and human beings simply interfere with and destroy that balance. Current public debates on "nature conservation" and "ecology" often enough have little to do with recent findings in scientific ecology. Consequently, some authors claim that the findings of recent ecological currents which indicate a general change of understanding from the idea of a natural ecosystem-balance to something that is naturally in constant flux, have led to many of the failures of environmentalism (Botkin 1990; Pahl-Wostl 1995; Pimm 1991). However, even if sociologists accept that there are at best time-space limited types of equilibriums, it is one thing to register and analyze these new discourses on the natural world, it is another issue to take seriously the self descriptions of actors to be analyzed and thus let these self-descriptions enter into sociological theory building. If environmental sociologists agree that the contributions of sociological research are part of modern society and thus are analysis *and* self-description of society (Luhmann 1984), sociology itself becomes a challenge for sociological theory since it included a reflexive awareness that it is part of societal language games and discourses. Thus understood, the theoretical frameworks of sociology cannot be immunized towards the discourses and the activities being observed. In other words, if sociologists today take seriously the self-descriptions of ecological practitioners and current discourses such as the debates on climate change, then the non-human needs to be given its "own voice," perhaps even the status of independent variable in sociology proper, as Catton and Dunlap called for in the 1970s. To this end, the need for a new ecological paradigm even makes sense from a general sociological theory perspective. Consequently, with changing environmental and social dynamics, environmental sociology on both sides of the Atlantic has developed new conceptual approaches and is also acknowledging that the early call for a new ecological paradigm needs to be taken seriously after all. These reactions and, in this sense, the first steps into new sociological realms are the main focus we want to highlight in the articles collected and that we as editors want to present under two book covers.

Sociological Reactions to New Discourses on the Natural World

Although environmentalism is a heterogeneous mix of science, politics, ecology, and culture, environmental thought in all areas since the 1970s can be divided into the camp of those who favor conservation and preservation of nature for nature's sake – sometimes refereed as ecocentric or biocentric views – and those who wish to maintain the environment a necessary habitat for humankind – sometimes referred to as the anthropogenic or anthropocentric view. Current trends such as global environmental modernization and processes of economic, political and socio-cultural globalization and transnationalization, fuelled by developments of transport, communication and information technologies, have fostered new conceptual approaches that move beyond 1970s conservationist, nation-state oriented mind-sets. The focus has been broadened from preserving the environment in its current status towards proactively shaping environment-society-configurations within the guiding vision of sustainable development. These concepts range from discussions in *Actor Network Theory* (cf. Voss and Peuker 2006), Marxist theory (cf. Foster 1999), and different approaches looking at the metabolism between nature and society (e.g., Fischer-Kowalski et al. 1997; Becker and Jahn 2006). Most recently, concepts such as that of environmental networks and flows (e.g. Mol, this volume) as well as practice theory (e.g. Brand, this volume) have stirred some debate among environmental social scientists. It is a change of sociological perspective, which Gille (2009) has nicely summarized as "from nature as proxy to nature as actor."

In order to sociologically grasp the uncertainty inherent in "nature as actor" interacting with human decision making and planning, recent debates in the environmental social sciences have also focused on topics such as environmental governance and multi-level decision-making, research in risk, vulnerability, adaptation, ecological design and experimentation – especially with regard to climate change, biodiversity and ecosystem management or dynamics between (global) environmental change and culture. Within these research endeavors many environmental sociologists in Europe have become involved in inter- and transdisciplinary environmental and sustainability research programs. In sum, environmental sociology has considerably opened up its research perspectives during the past 10–15 years. Nowadays a multitude of different conceptual approaches exist next to each other. On a more abstract level, however, it is possible to divide today's sociological debates on environment-society-interactions into three major types based on their implicit notions of nature:

1. *Focus on the reduction of societal impact on the natural environment*: This type of studies aims at issues of nature protection, preservation, prevention and mitigation. Many studies on environmental awareness or on nature conservation and biodiversity can be filed under the rubric of reduction of human environmental impacts. However, many environmental sociologists have used these topics as unfolding a critical stance towards modern society's morphing of the natural world, as in some streams of critical theory (Görg 1999; Wehling 2002). In this category we can also file studies on sustainable consumption, the North American concepts of the treadmill of production (Schnaiberg 1980; Schnaiberg and Gould 1994) or more recently the IPAT-approach (Impact = Population + Affluence + Technology) and discussions of the ecological footprint (Dietz and Rosa 1994; York et al. 2003) as well discussions on the Marxian notion of the

"metabolic rift" (Foster 1999) by linking back sociology to its often neglected classical foundations.

2. *Restoration of environmental degradation and the design of new ecosystems*: In this category belong studies on brown-field developments, ecological revitalization studies, or ecological restoration. The attitude behind these point to a reversion of traditional approaches to nature and represent attempts beyond the fatalism implicit in much of the mainstream environmental thought since the late 1970s (cf. Higgs 2003; Baldwin et al. 1994; Jordan 2003). Here the focus is on re-construction of 'nature' or 'environment' after destruction (anthropogenic or by natural dynamics) or pollution. These ideas are challenging for environmental sociology because they place an emphasis on intervening with and into nature through an interaction between society and the powers of the natural world, that is, they take seriously the idea that there never has been and never will be a balance of nature (Gobster and Hull 2000; Gross 2003; Helford 1999).
3. Directly linked to these streams of thought and their sociological reflections are concepts that try to focus on societal *interventions to (projected) environmental impacts on society*. Studies in this category focus on the analysis of social adaptation to changing natural conditions, which are caused by natural as well as human-influenced environmental dynamics (earthquakes, volcano eruptions, flooding or global climate change). This is not to imply that there has been no research on human impact on the environment, but it certainly has not been at the forefront of environmental sociological research during the last 30 years, where the implicit focus has been on the potential to reduce societal impact on the natural environment. However, so far environmental sociologists have mainly been working in the first area and are only since a decade beginning to fathom the importance of recent developments in ecology and the accompanying public discourse on the issue, which can be summarized as a trend from "protecting nature from human influence to protecting humans from (socially altered) nature."

Most important, the latter two research streams perhaps most explicitly jettison any the static notion of nature on which sociology for so long could build its implicit foundations. One possibility is a more realist attempt to include nature objectively, "as it really is" (cf. Murphy 2006). However, realist streams in sociology have encountered a problem on when to take seriously the powers of the natural world for the understanding of social processes and when to concentrate of the social factors. Quite often environmental sociologists loosely switch back and forth between "natural" and "cultural" explanations without a discernible order, since their theoretical underpinnings do not help them to do this. Many environmental sociologists are left alone to use nature as an explanatory variable when common sense or their ideological presuppositions call for it, and social and cultural explanations when it seems feasible from an everyday understanding. Unexpected results that would gainfully move beyond an intuitive part-nature/part-culture explanation are thus unlikely. Consider an example. On the one hand, many US environmental sociologists are proud to point out that they have "won" a debate against European ecological modernization theorists and their narrow focus on the institutional changes and purely cultural issues of ecology related reforms (Fisher and Freudenburg 2001; York and Rosa 2003). In addition, US environmental sociologists proudly point to their critical and realist tradition to environmental issues, their notions of materialism (e.g., the Marxian theory of metabolic rift) and other rhetorics at "taking the environment seriously." Interestingly enough, when it comes to extreme events such as hurricanes or floods all explanations of the material (wind, water) environment itself mysteriously become externalized again and the natural powers are not used as variables for explaining the disaster (cf. Williams 2008). Why is this? Perhaps when it comes to extreme weather, the ideological background of certain theoretical musings simply does not really leave much room for nature to have say, given that the blame can be put on purely social issues (e.g., the system's fault, greedy politicians and the like). In the end, however, and to put it bluntly, perhaps after all it is also more "nature, and not human activity that rules the climate," to paraphrase Singer's (2008) controversial title of a report to the IPCC.

However that may be, these types of discussions on climate change and extreme natural events will certainly spur to fill a desideratum of many streams in sociological research. Only during the last couple of years – due to an increasing attention of science, policymaking and society at large to global climate change and its local consequences – the issue of adaptation has attracted more research interest (cf. Dunlap and Marshall 2007: 337). At the same time discussions on solutions to environmental problems as well as forging interdisciplinary connections (rather than on detached analysis of environmental issues) and transdisciplinary experiments involving scientists and practitioners have gained in importance.

Before this background the volume will present environmental sociological debates on recent developments (mainly, but not exclusively) from a European angle. This book arouse out of conversations between the two editors and many colleagues around the world. Based on several conferences during the last decade where we discussed current issues and interdisciplinary trends in environmental sociology, we are now in a position to present a selection of new developments and novel attempts of sociological understandings of modern and global societies' changing relationships with the natural world. We hope that the book will help to foster exchange on current environment-related issues between international environmental sociologists and related (sub)disciplines such as science and technology studies, communication studies, ecological economics, political science, human geography, environmental psychology or environmental political science.

From a different angle, but closely related to the above array of challenges and themes, in some streams of sociology the claim was made that new environmental movements, citizen initiatives and other forms of non-formal politics are a force to rethink traditional sociological categories as well as forms of policy and decision making. Authors like Beck (1999) take the world-wide public perception of ecological risks and the engagement in non-formal ecological organizations as an indicator that informal types of political activity, what Beck called subpolitics, have taken on a greater significance in modern societies and need to be faced as a challenge to traditional forms of theorizing the human place in nature, as well as how ecological thinking emerges and connects with environmental politics and governance. Furthermore, if this discourse is going hand in hand with an understanding of humans as part of a dynamic and ever changing ecological foundation, environmental sociology is well advised to rethink some of its traditional approaches to a fixed differentiating between a dynamic society and a nature in balance. Some sociologists already claim that in the twenty-first century the intertwinement between the natural and the human realm becomes so large that focusing solely on the social side will not do justice to understand contemporary societies (cf. Latour 2004; Murphy 2002).

In this book, we present the above highlighted new trends as reactions to new discourses on the environment in a threefold manner: we will *first* present some recent theoretical debates of sociological reflections on the natural world and global environmental flows, we will *secondly* point to the time honored social scientific challenge of the rational actor, its novel attempts to simulate this actor, and the role of environmental knowledge within democracies. We have *thirdly* linked these debates to concrete examples of social learning and social (sustainable) practices and its relevance for transdisciplinary approaches. In the *fourth* and final part of the book, we will link these debates with new research on ecological communication and risk to current debates on adaptation policies and experimental approaches in ecological design and restoration. With the selection of papers we aim at bringing together new and further developed perspectives regarding the above mentioned three basic patterns of research on environment-society-interaction and contributing to the advancement of environmental sociology as subdiscipline within inter- and transdisciplinary sustainability studies.

Natural Flows and Global Environmental Discourse

The first article by Arthur Mol discusses three chronological perspectives for understanding environmental reform within environmental sociology: policy and protests (1970s and 1980s), ecological modernization (1990s till now) and environmental sociology of networks and flows (currently in development). The latter can be seen as a reaction to current discourse on ecology and nature, as we have discussed above. Mol's chapter gives a basic idea on strengths and weaknesses of these three traditions and ends with how this new perspective relates to the earlier ones. Mol's is thus a theoretical article discussing the developments in establishing a sociology of environmental reform next to the conventional sociology of environmental deterioration. Connections to general sociology are noteworthy here. It is especially Manuel Castells' relation between the space of flows and the space of place and John Urry's emphasis of evolutionary dynamics at the expense of human agency that Mol's paper contributes to and will thus help to develop a new agenda for environmental sociology in the twenty-first century. In this vein, Fritz Reusswig's chapter delivers us an analysis of the shifting social discourse on climate change in Germany and the U.S. Climate Change Discourses (CCD) are defined as thematically focused coupled sequences of arguments that different social actors use in order to influence one another or their social contexts in order to improve the chances of their resource endowments, interests, and worldviews to prevail in collective decision making processes. This shift occurs currently more markedly in Germany than in the U.S., but, after the Presidential elections of 2009, has also caught up across the Atlantic. His final section sketches the outlines of a low-carbon society and discusses some major challenges to environmental sociology such as critical assessments of socio-technical experiments which can be seen as an important issue in fathoming possibilities of societies' adaptation strategies in the twenty-first century.

Despite Reusswig's important contribution, it needs to be stressed that environmental sociology has been relatively late to take up issues of environmental regulation, especially issues of global environmental governance. Frank Biermann, a political scientist by training, takes up the issue and discusses new trends in debates on earth system governance in their relation to debates in environmental sociology. He shows how the discourse on global environmental governance has moved towards earth system governance and which conceptual and institutional innovations are connected with this development. Next to institutional questions – the specific domain of political sciences – he points to the need to pay more attention to issues such as social inequality and power distribution, that is, classical sociological themes.

To further the relevance of flows and the diffusion of ecological innovations (Mol), shifting social discourse on climate change (Reusswig) and the challenges of global governance regimes (Biermann), the article by Baerlocher and Burger attempts to frame environmental problems, technological risks and the discourse concerning sustainable development in a novel way. Their concept of "ecological regimes" aims to develop an integration of the biophysical world into existing social theory. Due to their view on the constitution of the "social," Baerlocher and Burger argue, society and culture have often been conceived as being detached from biophysical matters, and, therefore, there is no place to integrate biophysical elements into social theories. However, although several theories try to overcome this theoretical weakness and strive to integrate the biophysical world into social theory, the approaches mostly focus either on the level of individual action or on the macro level only. On this basis, the paper goes back to the North American origins of the new environmental sociology and scrutinizes Catton and Dunlap's call from the 1970s for a New Ecological Paradigm and the current reawakening of Marx's theory of societal metabolism to enlarge the latter by the level of aggregated action considering social structure. As a result the authors present their own concept of "ecological regimes," informed also by current research in human geography and aims to integrate the biophysical environment on an institutional level into social theory without being deterministic and reductionist.

Exploring Limits and New Possibilities for Understanding Environmental Rationalities

Although purposive social action has provided a foundation for many theoretical developments in economy and other social sciences, sociology, has always harbored a “contrarian vocation” (Portes 2000) to rational social action. Instead, sociology has focused on the unexpected and emergent consequences of goal-oriented activity. It is thus no wonder that sociological research in rational choice theory has also been prominent in environmental sociology as it has in neighboring disciplines, especially in psychology. Steven Yearley, the first author in our thematic topic on environmental rationalities, discusses precisely the “rationalities” for assessing the supposed environmental and ethical consequences of new technologies using the case of synthetic biology as a touchstone. Yearley is especially interested in the European aspect of synthetic biology, since it relates the bioeconomy agenda for making the European Union more competitive. The life sciences are one of the key themes for innovative Europe and synthetic biology is a leading candidate for dramatic innovation in the life sciences.

New approaches to rational behavior, new methods of social simulation to investigate environmental change from a social science perspective will be discussed in Andreas Ernst’s chapter. To be sure, environmental behavior is a complex issue. The natural environment itself can be considered as a complex system since it possesses a high number of variables that are highly interconnected, which results in a structure that is non-transparent to us, and that produces dynamic behavior. There are numerous heterogeneous actors that are interconnected through strong social interactions, which are embedded in multiple levels of institutional and cultural layers which act as normative guideline to individuals. Moreover, environmental behavior often has a strong spatial relation that manifests itself on multiple, i.e. local, regional, and global scales. In Ernst’s chapter, the method of social simulation is proposed to deal with issues arising from the complexity addressed above.

Given the increasing discourse on uncertainty in contemporary decision making, trust is an essential feature regarding a more realistic understanding and modeling of social interactions. Stefan Walter further develops the system theoretical take on trust as a mechanism to reduce social complexity. As trust is located in the relations between people, it should be seen as a characteristic of collective units – of social systems – and as a prerequisite for the functioning of society. The alternative to trust into social relations would be chaos. Trust works as a foundation for society upon which planning, justice etc. are only possible. Hence, the maintenance and strengthening of trust is a requirement for governing and sustaining governance structures, e.g. through maintaining the value of money and supporting its continued circulation as a form of cooperation. Therefore, maintaining trust and cooperation in environmental decision making will more and more be the priority of policy making. In a way, ecological modernization serves to sustain the development and progress of society through accelerated modernization. It is an effort to remove or minimize possible conflicts that could emerge out of dealing with resource dependencies in society and, hence, provides a continuing basis for environmental justice and governance.

In their chapter on new trends in rational choice theory (RCT), Ulf Liebe and Peter Preisendörfer show a keen eye on processes and possibilities of ecological modernization. Increasingly RCT can be considered a multidisciplinary approach developed and applied by, among others, economists, political scientists, and sociologists. The major aim is to explain social outcomes on the macro level using assumptions about rational individual behavior. Over many years RCT has made valuable contributions to environmental sociology and environmental research respectively. Liebe's and Preisendörfer's chapter addresses variants of RCT, selected applications in the field of environmental sociology and points to new trends in RCT and the environment by giving an overview of RCT including basic concepts and variants such as game theory. New applications of RCT in environmental sociology include the explanation of environmental behavior, the correlation between environmental attitudes and behavior, environmental problems as social dilemmas, and economic valuation of environmental goods.

Even though model-based knowledge has gained in attractiveness for political decision-making, especially with regard to modeling of climate change and socio-economic systems, this does not mean, that there is an easy relationship between (expert) knowledge and action in democracies. In this perspective Pellizzoni's chapter explores the relationship between environmental knowledge and deliberative democracy. He starts out by an analysis of the distribution between cognitive abilities and disabilities implied in the "social contract for science," suggesting that the demand for participation (and the offer of participatory devices) depends on a crisis of legitimacy of this division of labor. Pellizzoni furthermore discusses the development in the last 30 years from a focus on risk to uncertainty by addressing current replies to the growing relevance of uncertainty, distinguishing four approaches. Most of them seek to reduce uncertainty to risk or to confine it into 'safe' social realms. The last one instead openly acknowledges the interplay between matters of fact and matters of concern. At this point, environmental governance meets deliberative democracy. The latter has been regarded as a viable reply to the growing problems of legitimacy and effectiveness of environmental policies. Overall Pellizzoni's argument is that most deliberative designs do not aim to cross the border between traditional and innovative conceptions of the division of labor in the production of social knowledge on the environment. However, crossing borders, as self-proclaimed radical approaches ask for, does raise problems of its own.

Transdisciplinarity and Sustainable Development

As was set forth by Frank Biermann, environmental and earth system governance aims at enabling societal transitions towards sustainable development. However, from a sociological perspective, a most important factor in transformation processes is social learning, especially in times of uncertainty. Bernd Siebenhüner und Harald Heinrichs argue in their article that widespread behavioral change towards sustainable development will not only happen through state regulation and market incentives. Without broader individual, organizational and societal learning processes, shifts towards sustainable consumption and production patterns will remain limited. These forms of social learning require expert and scientific knowledge as well as lay knowledge on applied solutions towards sustainability. How these processes of knowledge generation, processing, diffusion and uptake in real action occur, develop and end, is studied by a number of concepts that are analyzed in the chapter. These include formal and informal (individual) learning, organizational learning, inter-organizational learning, policy learning, as well as broader societal learning. The chapter is rounded up with some relevant influencing factors of learning processes and a discussion on how to initiate and foster these kinds of processes.

Learning, however, becomes even more challenging in inter- and transdisciplinary contexts. In his contribution on transdisciplinary as a possible means for societal learning in sustainable development, Michael Stauffacher discusses the question to what extent stakeholder involvement is just another form of corporatist regime and how the method of transdisciplinary case study (TdCS) can provide added value by initiating collaborative learning processes. In this understanding, the term transdisciplinary refers to a form of knowledge production whereby a mutual learning process between science and people from outside academia is aspired. Case studies are used as phenomena investigated in sustainable development that cannot be separated from their context. Cases are unique, but always related to something general. The TdCS goes well beyond neocorporatism: the role played by science is emphasized; a larger number of stakeholder groups are involved; the regional is more important than the national level; hierarchical, central steering of decision process is replaced by a more networked form; it is conceptualized more as mutual learning process than as interest negotiation; and a more project-oriented flexible approach substitutes institutional arrangements. Concurrent with the overall theme of the book, Stauffacher's chapter concludes by showing some implications from this macro-sociological perspective for interdisciplinary design and similar approaches.

Subsequently Karl-Werner Brand, one of the most eminent researchers of environmental movements in the German speaking world, brings up the question whether today's strategies for promoting sustainable behavior and consumption in Europe are adequate. Using Germany's so called consumption boom of organic food as a touchstone, Brand challenges the traditional model of the dynamic interrelations between the systems of production and consumption, but instead suggests a practice-theoretical approach, which brings the complex character of consumption practices to the fore. A basic element in Germany's "boom" was the promotion of organic farming which should bring organic food from the niche to the center of German food markets. Brand discusses this case with the framing of practice-theoretical approaches to help understand the complex processes of changing consumption patterns and to clarify the preconditions of promising strategies to influence and change consumption patterns.

Besides sustainable consumption, many European environmental sociology debates have taken up the challenge of sustainable transportation systems. Henrike Rau adds an Irish perspective to the proclaimed new "mobility turn" in some social sciences. This stream of research links back many of the interdisciplinary connections of contemporary environmental sociology to classical issues of social inclusion and exclusion by identifying the complex and often contradictory social forms of being mobile. Different types of mobility and immobility are indeed central to understanding the relations between society and its biophysical environment. Furthermore, as Rau contests, in the future problem-oriented research on sustainable transport systems needs to even more move beyond conventional, static concepts of environment-society relations to better understand locally embedded social actors and the continuous power of territorially bound nation-states on the one side and global political and economic processes on the other.

Ecological Communication, Adaptation Policies and Social Experimentation

Taking a broader perspective on environmental communication, Heinz Bonfadelli subsequently defines communication within the wider discipline of communication research in the first part of this contribution. Beyond citizen participation and stakeholder cooperation in governance contexts the mass media plays an important role for societal communication especially in oftentimes abstract and complex environmental issues. According to Bonfadelli environmental sustainability poses a challenge for media and journalism, because its long-term and integrative perspective does not fit immediately to journalistic routines.

Beyond media communication in recent decades debates on how to "robustly" integrate views on social acceptability and scientific reliability via experimental approach have gained in importance on a European level, although the original ideas stem from North America. Christine Overdevest, Alena Bleicher and Matthias Gross will illustrate the challenges of an experimental turn for environmental sociology and its pragmatist implications. If our contemporary time is characterized as the era of the emerging knowledge society, then this would be a society of collective experimentation (Felt et al. 2007; Latour 2004). In this article, based on the pragmatist visions of John Dewey and the classical Chicago School of Sociology's concept of the city as a laboratory, this article discusses a European take on dealing with ignorance in ecological decision making. Overall, this chapter is aimed to assess the positive potentials of human societies' relations with the natural world, which also means a tolerant attitude towards uncertainly, experimentation and new forms of participation. Building on these discussions, Piet Sellke's and Ortwin Renn's contribution develops further the risk governance framework for new forms of participation as originally put forward by the International Risk Governance Council (IRGC). This is an integrated analytic framework which provides guidance for the development of comprehensive assessment and management strategies to cope with risks, particular at the global level. The framework integrates scientific, economic, social and cultural aspects and includes the effective engagement of stakeholders. The framework reflects IRGC's own priorities, which are the improvement of risk governance strategies for risks with international implications and which have the potential to harm human health and safety, the economy, the environment, and/or the fabric of society at large.

Finally, Harald Heinrichs presents a theoretical-conceptual approach to frame communication processes on societal adaptation to local and regional consequences of global climate change. Next to the dominating issues of prevention and mitigation (e.g. reduction of CO_2 emissions) as well as restoration (e.g. reforestation), today a growing awarenes of the need for adaptation is arising. Because of the complexity of adaptation strategies and the coordination of natural and societal issues, communication will play a pivotal role. However, so far there has been little emphasis to conceptualize and analyze adaptation-oriented communication processes. Based on established approaches such as disaster, risk and sustainability communication, this final chapter outlines an integrative concept of adaptation communication for the twenty-first century.

Outlook

Overall, a common theme of this book is that uncertainty and risk are not themes and issues to be avoided, but are likely and – in some cases – need to be perceived as unavoidable. However, instead of discussing despair, they can mean a basis for social learning and thus successful adaptation to changing environmental and social states. However, it is these challenges that also call for inter- and transdisciplinary collaboration efforts (cf. Hadorn et al. 2008). In a way, it is exactly these sociological attempts to take seriously the surprising and indeed shocking disasters that indicate the unexpected activities, and as such taking seriously the natural powers in order to internalize autonomous nature into our sociological analysis of society (Murphy 2002). However, political leaders and policymakers still tend to afford unexpected natural events low priority and keep them behind rhetorics of safety and certainty. After all, trumpeting certainty and attacking claims to the contrary is always more convincing in the public realm than acknowledging ignorance or further risks (cf. Pielke 2007). We hope that the chapters in this book will deliver a few hints on how to move beyond the focus on safety by forging links and syntheses that connect to neighboring disciplines to deliver a better understanding of current societies' relationships with the natural world. By doing so, we hope that the contributions in this book can support a further development of current debates on reflexive modernity, transdisciplinarity in the knowledge society, globalization and ecological modernization, experimental forms of sustainability, or the many debates surrounding Beck's (cf. 2006) and others' notion of cosmopolitanism in globalizing modernity and its relevance for world societies' interaction with and dependence from the natural environment.

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Part I
Natural Flows and Global Environmental Discourse

Chapter 2
Social Theories of Environmental Reform: Towards a Third Generation

Arthur P.J. Mol

Abstract For quite some time environmental sociology has been preoccupied with understanding the fundamental causes of environmental crises. It is only since the 1990s that attention has shifted stronger to understanding environmental reform. This contribution reviews three generations of environmental sociological theory on environmental reform, labelled 'policies and protests', 'ecological modernisation', and 'networks and flows'. The three bodies of social theory follow each other chronologically, and have been developed against the background of the specific social order of that time. But they all still have their relevance in understanding how contemporary modern society copes with environmental crises and challenges.

Keywords Environmental protests • Environmental governance • Ecological modernisation • Networks and flows • Globalisation

From Environmental Crises to Environmental Reform

During the late 1960s, and especially the 1970s several social sciences witnessed the emergence of relatively small environmental subdisciplines: within sociology, political sciences, economics, and later also within anthropology and law. Strongly triggered by social developments in Western industrialised societies, social scientists started to reflect on a new category of phenomena: the changing relations between nature and society and the reflection of modern society on these changing relations.

In retrospect, the framing of environmental questions within sociology and political sciences during the 1970s and 1980s was of a particular nature. The emphasis was primarily on the fundamental causes of environmental crises in Western

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industrialised society and the failure of modern institutions to adequately deal with these environmental crises. Environmental protests and movements, state failures, the capitalist roots of the environmental crisis, and environmental attitudes and (mis)behaviour were the typical subjects of environmental sociology and political sciences studies in the 1970s. Many of these studies were strongly related to neo-Marxist interpretation schemes (cf. Enzensberger 1974 [1973]; Schnaiberg 1980; Pepper 1984), and even today neo-Marxism is a powerful and far from marginal explanatory theory in environmental social science research.[1]

It is only by the late 1980s, and especially in the 1990s, that attention in environmental sociology and political sciences started to change somewhat toward what the sociologist Buttel (2003) has labelled the social sciences of environmental reform. Strongly driven by strategic and ideological developments in the European environmental movement, and by the practices and institutional developments in some 'environmental' frontrunner states, European sociologists and political scientists began reorienting their focus towards environmental reforms (only later and sometimes less strongly to be followed by U.S. and other non-European environmental social scientists). In this contribution, I will review these social science contributions to understanding environmental reform, by focusing on three generations of social theories.[2] Although these three generations have an historical dimension in that each has been developed in a specific period (and geographical space), they are not mutually excluding or full alternatives. First-generation theories on policy and protests are still applied and relevant today, be it in a somewhat different mode as initially developed in the 1970s. In addition, insights from the first-generation theories have often been included in reform theories of later generations.

First-Generation Theories: Policies and Protests

Although emerging as a more central theme in environmental sociology and political sciences only in the late 1980s, the subject of environmental reform also has been around in the early days of the environmental social sciences. In its birth days in the 1970s (cf. Mol 2006; Buttel 2002; Dunlap 2002), American and European environmental sociology and political sciences dealt with environmental reforms predominantly via two lines: analysing national environmental policies and environmental state formation, and studying environmental NGOs and protests.

[1] Arguably, this currently is more the case in the United States than in European countries. For a comparison between the developments of U.S. and European environmental sociology (including the position of neo-Marxism), see Mol (2006).

[2] It goes without saying that such a focus and emphasis on environmental reform studies/approaches does not disregard other environmental social sciences traditions (e.g., attitude-behaviour paradigms; political economy views; social constructivist perspectives; cultural theories) as being irrelevant. Several of these other perspectives are drawn into our analysis later in this paper.

As environmental problems and crises were mainly conceptualised as (capitalist) market failures in the provision of collective goods, the emerging environmental state institutions were widely conceived as among the most important developments to deal with these failures. The establishment of national and local environmental ministries and authorities, new national frameworks of legal measures and regulations, new assessment procedures for major economic projects, and other state-related institutional innovations drove sociological and political sciences interests, analyses, and investigations towards understanding environmental reform processes. To a significant extent, these analyses were sceptical of the nation-state's ability to 'tame the treadmill' (Schnaiberg 1980) of ongoing capitalist accumulation processes and related environmental deterioration. Building strongly on neo-Marxist analytical schemes, the state was often perceived to be structurally unable to regulate, control, and compensate the inherent environmental side effects of an ongoing capitalist accumulation process. The environmental crisis was seen as being closely and fundamentally related to the structure of the capitalist organisation of the economy, and the 'capitalist state' (Jessop 1990) was considered to be unable to change the structure of the capitalist economy. Jänicke's (1986) study on state failure accumulated many of the insights and themes of this line of investigation. Notwithstanding this dominant position during the birth period of environmental sociology and political sciences, some did see and analyse the environmental state as of critical importance for environmental reform. This was the case, for instance, with tragedy of the commons/free-rider perspectives, more applied policy science analyses, or Weberian rationalisation views. Much research was normative and design-oriented, focusing on the contribution to and development of new state-oriented institutional layouts for environmental policy and reform. Environmental Impact Assessment schemes, environmental integration models, policy instruments, control and enforcement arrangements, and the like were typical subjects for agenda-setting and implementation research.

Environmental nongovernmental organisations and civil society protests formed a second object of early environmental social science research on environmental reform. Investigations into local community protests on environmental pollution and studies on local and national environmental nongovernmental organisations constituted the core of this second branch of environmental reform analyses in the 1970s and early 1980s. The resource mobilisation studies in the United States (cf. Zald and McCarthy 1979; McCarthy and Zald 1977) and the new social movement approach in Europe (cf. Offe 1985; Klandermans 1986) were two dominant perspectives among a wide range of studies that tried to understand the importance of civil society in bringing about social transformations in the core institutions of modern society. In addition to a clear emphasis on the protests against what were seen as the fundamental roots of the environmental crises (Pepper 1984), many studies also focused on the contribution of the emerging environmental movement to the actual and necessary reforms of the modern institutional order, be it via escapism in small communities detached from the dominant economic (and often also political) institutions (cf. the 'small is beautiful' postindustrial utopians; Frankel 1987); via public campaigning against polluters; via lobbying and influencing political processes; or via awareness raising and attitudinal changes of citizens and consumers. Among environmental sociologists there was often a significant degree of sympathy with, and even involvement in, these new social movements. Many of the more radical and structuralist analyses of the 'roots of the environmental crises' saw – and still see – the environmental movement as the last resort for bringing about change and reform.

Arguably, one could even add a third category to environmental reform studies in the 1970s, be it that this category was stronger psychology – in stead of sociology or political science – based: research on environmental values, attitudes and behaviour. Strongly rooted in psychological models and theories a new line of investigation developed in the 1970s, relating changes in environmental values and attitudes of individuals to behavioural changes. Ajzen and Fishbein's (1975, 1977) model of reasoned action formed the basis for much fundamental and applied research, trying to relate polling and surveys on environmental values with concrete environmentally (un)sound behavioural actions and changes in social practices. In sociology, Catton and Dunlap's (1978a, 1979b) dichotomy of Human Exemptionist Paradigm (HEP) and the New Ecological Paradigm (NEP) formed a strong model for survey research, although it was initially developed to criticise the mother discipline for failing to take environmental dimensions into account in explaining social behaviour.

Reviewing in retrospect these contributions to social science research on environmental reform, one can draw several conclusions. First, with Buttel (2003) one can conclude that in the 1970s and 1980s the majority of the environmental social science studies were not focused on explaining environmental reform, but, rather, on understanding the continuity of environmental degradation. Second, among the relatively few environmental reform studies conventional political and civil society institutions received most attention, whereas economic institutions and organisations, or mixes (hybridisations) of institutions/organisations, were almost absent. This was, of course, related to the actual state of environmental transformations in OECD countries during the 1970s and 1980s. Third, although during that period neo-Marxist perspectives dominated the sociology/political sciences of environmental devastations, no clear single dominant theoretical perspective emerged among the variety of environmental reform studies. Fourth, although these traditions in studying environmental protest, politics, and attitudes originate in the 1970s, they still have strong positions in contemporary social sciences research on the environment. This is clearly illustrated in the environmental programmes of the annual, two-yearly or four-yearly conferences of, respectively, the American (ASA), the European (ESA), and the International Sociological Association (ISA).

Second-Generation Theories: Ecological Modernisation

From the mid-1980s, but especially since the early 1990s, an explosion of empirical studies have emerged on environmental improvements, ecological restructuring, or environmental reform. These studies have focused on distinct levels of analysis: individual producers, households, or social practices; industrial sectors, zones, chains, or networks; nation-states or countries; and even global regions. These studies all tried to assess whether a reduction in the use of natural resources and/or the discharge of emissions can be identified, either in absolute or in relative terms, compared to economic indicators such as GNP. This development is manifest in studies on cleaner production, industrial metabolism, or industrial ecology; investigations on dematerialisation and factor four/ten; and perspectives on the greening of consumption, lifestyles, and households. Although most of these empirical studies emerged in developed OECD countries, many of them have – be it often a little later – also found their way to less developed parts of the globe.

Although not all of the conclusions in these studies point in the same direction, the general picture can be summarised as follows. From the mid-1980s onward, a rupture in the long established trend of parallel economic growth and increasing ecological disruption can be identified in most of the ecologically advanced nations, such as Germany, Japan, the Netherlands, the United States, Sweden, and Denmark. This slowdown is often referred to as the decoupling or delinking of material flows from economic flows. In a number of cases (regarding countries and/or specific industrial sectors and/or specific social practices and/or specific environmental issues), environmental reform has even resulted in an absolute decline in the use of natural resources and/or in discharge of emissions, regardless of economic growth in financial or material terms (product output). These conclusions are sometimes also valid for rapidly industrialising and modernising countries in, for instance, Asia (e.g., Sonnenfeld and Mol 2006).

The social dynamics behind these changes, that is, the emergence of actual environment-induced transformations of institutions and social practices, became one of the key objects of social science research in the 1990s. I will group the studies that try to understand, interpret, and conceptualise the nature, extent, and social dynamics of environmental reform processes in this era under the label of ecological modernisation.

Fundamentals of Ecological Modernisation

The basic idea of ecological modernisation is that, at the end of the second millennium, modern societies witness a centripetal movement of ecological interests, ideas, and considerations in their institutional design. This development crystallises in a constant ecological restructuring of modernity. Ecological restructuring refers to the ecology-inspired and environment-induced processes of transformation and reform in the central institutions of modern society.

Within the so-called Ecological Modernisation Theory this ecological restructuring is conceptualised at an analytical level as the growing autonomy, independence, or differentiation of an ecological rationality vis-à-vis other rationalities (cf. Dryzek 1987; Mol 1995; Spaargaren 1997). In the domain of states, policies and politics the emergence of an ecological rationality emerged already in the 1970s and early

1980s, and ‘materialised’ or ‘institutionalised’ in different forms. The construction of governmental organisations and departments dealing with environmental issues dates from that era. Equally, environmental (framework) laws, environmental impact assessment systems and green political parties date back to that period. The same is true in the domain of ideology and the life world. A distinct ‘green’ ideology – as manifested by, for instance, environmental NGOs, environmental value systems, and environmental periodicals – started to emerge in the 1970s. Only in the 1980s, however, this ‘green’ ideology assumed an independent status and could no longer be interpreted in terms of the old political ideologies of socialism, liberalism, and conservatism, as argued by, among others, Paehlke (1989) and Giddens (1994).

However, the crucial transformation that makes the notion of the growing autonomy of an ecological rationality especially relevant, is of more recent origin. After an ecological rationality has become relatively independent from the political and socio-ideological rationalities (in the 1970s and 1980s), this process of growing independence began to extend to the economic domain in the 1990s. And because, according to most scholars, this growing independence of the ecological rationality from its economic counterpart is crucial to ‘the ecological question’, this last step is a decisive one. It means that economic processes of production and consumption are increasingly analysed and judged, as well as designed and organised from both an economic *and* an ecological point of view. Some profound institutional changes in the economic domain of production and consumption have become discernable in the 1990s. Among these changes are the widespread emergence of environmental management systems in companies; the introduction of economic valuation of environmental goods via the introduction of ecotaxes, among other things; the emergence of environment-inspired liability and insurance arrangements; the increasing importance attached to environmental goals such as natural resource saving and recycling among public and private utility enterprises; and the articulation of environmental considerations in economic supply and demand, for instance by ecolabels and other product information systems. Within ecological modernisation ideas, these transformations are analysed as *institutional* changes, indicating their semi-permanent character. Although the process of ecology-induced transformation should not be interpreted as linear, evolutionary, and irreversible, as was common in the modernisation theories in the 1950s and 1960s, these changes have some permanency and would be difficult to reverse.

Ecological Modernisation as Environmental Reform

Most ecological modernisation studies focus on actual environmental reforms in specific social practices and institutions. As I have indicated elsewhere (e.g., Mol 1995, 2001), an ecological modernisation perspective on environmental reform can be categorised in five themes.

First, there are studies on three new interpretations of the role of science and technology in environmental reform. Science and technology are no longer only analysed and judged for their contribution to environmental problems (so dominant in the 1970s and early 1980s), but also they are valued for their actual and potential role in bringing about environmental reforms and preventing environmental crises. Second, environmental reforms via traditional curative and repair technologies are replaced by more preventive sociotechnological approaches and transitions that incorporate environmental considerations from the design stage of technological and organisational innovations. Finally, the growing uncertainties with regard to scientific and expert knowledge and complex technological systems do not lead to a denigration of science and technology in environmental reform, but, rather, in new environmental and institutional arrangements.

A second theme covers studies focused on the increasing importance and involvement of economic and market dynamics, institutions, and agents in environmental reforms. Producers, customers, consumers, credit institutions, insurance companies, utility sectors, and business associations, to name but a few, increasingly turn into social carriers of ecological restructuring, innovation and reform (in addition to, and not so much instead of, state agencies and new social movements). This goes together with a focus on changing state-market relations in environmental governance, and on a growing involvement of economic and market institutions in articulating environmental considerations via monetary values and prices, demand, products and services, and the like.

A third theme in ecological modernisation relates to the changing role, position, and performance of the 'environmental' state (often referred to as political modernisation in Europe [cf. Jänicke 1993; van Tatenhove et al. 2000], or regulatory reinvention in the United States [cf. Eisner 2004]). This theme evolved in the mid-1990s in environmental governance studies. The traditional central role of the nation-state in environmental reform is shifting, leading to new governance arrangements and new political spaces. First, there is a trend towards more decentralised, flexible, and consensual styles of national governance, at the expense of top-down hierarchical command-and-control regulation. Second, there is a larger involvement of nonstate actors and 'nonpolitical' arrangements in environmental governance, taking over conventional tasks of the nation-state and conventional politics (e.g., privatisation, public-private partnerships [Glasbergen et al. 2007], conflict resolution by business-environmental NGO coalitions without state interference, and the emergence of subpolitics[3]). Finally, supranational and global environmental institutions and governance arrangements to some extent undermine the conventional role of the sovereign nation-state or national arrangements in environmental policy and politics. As I will outline later in this chapter, this is more than just a matter of scale; it is, rather, a fundamental change in environmental reform dynamics, in need for a different environmental sociology and political sciences.

[3] As Beck explains, "sub-politics is distinguished from 'politics,' first in that agents outside the political or corporatist system are allowed to appear on the stage of social design […], and second, in that not only social and collective agents but individuals as well compete with the latter and each other for the emerging shaping power of the political" (Beck 1994: 22).

Fourth, the modification of the position, role, and ideology of social movements (vis-à-vis the 1970s and 1980s) in the process of ecological transformation emerges as a theme in ecological modernisation. Instead of positioning themselves on the periphery or even outside the central decision-making institutions on the basis of de-modernisation ideologies and limited economic and political power, environmental movements seem increasingly involved in decision-making processes within the political and, to a lesser extent, economic arenas. Legitimacy, accountability, transparency, and participation are the new principles and values that provide social movements and civil society the resources for a more powerful position in environmental reform processes. Within the environmental movement, this transformation goes together with a bipolar or dualistic strategy of cooperation and conflict, and internal debates on the tensions that are a by-product of this duality (Mol 2000).

And, finally, ecological modernisation studies concentrate on changing discursive practices and the emergence of new ideologies in political and societal arenas. Neither the fundamental counterpositioning of economic and environmental interests nor a total disregard for the importance of environmental considerations are accepted any longer as legitimate positions. Intergenerational solidarity in the interest of preserving the sustenance base seems to have emerged as the undisputed core and widely shared principle, although differences remain on interpretations and on translations into practices and strategies.

Hence, all in all, this gives a much wider agenda of environmental reform studies compared to the 1970s and early 1980s, partly reflecting the changing practices of environmental reform in and between OECD countries.

Ecological Modernisation and Its Critics

From various (theoretical) perspectives and from the first publications onwards, the growing popularity of ecological modernisation studies and ideas has met opposition and criticism. Coming from subdisciplines that had been preoccupied with explaining the continuity of environmental crises and deterioration, such a move to environmental reform perspectives cannot but meet (fierce) debate. The debates and criticism on ecological modernisation have been summarised and reviewed in a number of publications.[4] Here I want to summarise these various critiques and debates in three categories.

First, several objections have been raised during the short history of ecological modernisation, which have been incorporated in more recent versions of the theory/idea. Although these objections against ecological modernisation made sense in

[4] For evaluations and critiques on the idea of ecological modernisation as the common denominator of environmental reform processes starting to emerge in the 1990s, see, for instance, Hannigan (1995), Christoff (1996), Blowers (1997), Dryzek (1997), Gouldson and Murphy (1997), Leroy and van Tatenhove (2000), Blühdorn (2000), Buttel (2000), Mol and Spaargaren (2000, 2002), Pellow et al. (2000), Pepper (1999), Schnaiberg et al. (2002), and Gibbs (2004).

referring to the birth period of ecological modernisation studies (cf. Sonnenfeld and Mol 2002), for more recent mature ecological modernisation approaches they are no longer adequate. This is valid, for instance, regarding criticism on technological determinism in ecological modernisation, on the productivist orientation and the neglect on the consumer, on the lack of power in ecological modernisation studies and on its Eurocentricity. Not withstanding the increased incorporation of these critiques in the majority (but not all) of ecological modernisation studies at the turn of the millennium, several scholars continue repeating them up until recently (e.g., Carolan [2004] on the productivist orientation; Murphy and Bendell [1997] on technological determinism; Gibbs [2004] on missing power relations).

Second, there are a number of critiques on ecological modernisation perspectives that find their origin in radically different paradigms and approaches. Neo-Marxist criticism by Schnaiberg et al. (2002; Pellow et al. 2000) emphasises consistently the fundamental continuity of a capitalist order that does not allow any environmental reform beyond window dressing.[5] Scholars inspired by deep ecology argue against the reformism of ecological modernisation, as it opts for a light green reform agenda, instead of a deep green fundamental and radical change of the modern order, sometimes even towards postmodernity. Human ecologists, sometimes inspired by neo-Malthusianism, blame ecological modernisation perspectives for their neglect of quantities, not in the last place population growth and ever growing consumption quantities. Consequently, ecological modernisation perspectives are blamed to be inadequate, overly optimistic/naive, and incorrect. It is not so much that these objections are completely incorrect. From their starting points and the basic premises of these schools of thought, the points raised against ecological modernisation are internally logic, consistent, and coherent. In various publications (Mol and Spaargaren 2000, 2002, 2004), however, we have argued that their focus is too narrow, limited, and one-sided, by claiming that there is nothing new under the sun. Although ecological modernisation scholars would not deny that in multiple locations, practices, and institutions environmental deterioration is still there, they object to the conclusion of these critics that no reforms can be identified in the institutions dealing with environmental challenges.

Third, and finally, there is a category of comments that is less easy either incorporated or put aside if we want to analyse and understand environmental reform in late modern society. These issues have to do with the nation-state or national society centeredness of ecological modernisation, the strong separation between the natural/physical and the social in ecological modernisation, and the continuing conceptual differentiation in state, market and civil society actors and institutions. Here it is especially the changing character of modern society – especially through processes of globalisation – that makes that new, early-twenty-first-century environmental reform dynamics are not always easily fitting ecological modernisation conceptualisations of the 1990s. This is not too dissimilar to the fact that the

[5] See also the work of Pepper (1999), Blowers (1997), and Foster (2002).

environmental reform dynamics of the 1990s did not fully fit the 'policy and protest' conceptualisations of the 1970s environmental reform studies. It is especially these comments and discussions on ecological modernisation that have started the development of what can be called the environmental sociology of networks and flows.

Third-Generation Theories: Networks and Flows

The second half of the 1990s witnessed the emergence of what we can now label the sociology of networks and flows. The foundation of a new sociological perspective, a new social theory or even 'new rules of sociological methods' (Urry 2003) never emerge with one publication, and also here several scholars are at its foundation. Crucial in the development of the sociology of networks and flows is the shift from states and societies as central units and concepts of analysis, to networks and flows of capital, people, money, information, images, goods/materials, and the like. These networks and flows form the true architectures of a global modernity.

It is beyond the scope of this contribution to provide a full overview, review, and assessment of the debates regarding the sociology of networks and flows. Others have done so with sufficient detail and balance.[6] Here we will especially focus on the main characteristics of this sociology of networks and flows, which are relevant to the environmental social sciences, and how this sociology (can) change(s) the agenda of environmental reform studies and perspectives. In doing so, we start with the work of Manuel Castells and John Urry.[7]

A Sociology of Networks and Flows

Although he judges Castells's (1996/1997) trilogy on the rise of the network society as the best effort so far to analyse networked modernity, Urry (2000, 2003) sets himself the task of elaborating and refining the conceptual apparatus as introduced by Castells. The two authors develop their analyses of time and space along very much the same track, although Urry does not make use of the dichotomy of the space of flows versus the space of place, which is so central to Castells's work. Instead, Urry suggests that one should approach spatial patterns in three ways or modalities, distinguishing among regions (i.e., objects geographically clustered together), globally

[6] See, for instance, Leydesdorff (2002), Simonsen (2004), and the various references in Mol and Spaargaren (2006).

[7] It goes without saying that there are numerous others that have contributed recently in developing such a new perspective, often each with his/her own terminology, emphasis and focus (cf. Kaufman 2002; Kesselring 2006; Graham and Marvin 2001; Bauman 2000; Rifkin 2000).

integrated networks (more or less stable, enduring, and predictable relations between nodes or hubs, stretching across different regions, with relatively walled routes for flows), and, finally, global fluids (spatial patterns determined neither by boundaries nor by more or less stable relations, but by large flexibility and liquidity). The networks and flows in these three categories are partly social and partly material or technical in character. Urry employs the notion of 'scapes' to refer to networks in their function of sociotechnical infrastructures: "networks of machines, technologies, organisations, texts and actors that constitute various interconnected nodes along which flows can be relayed" (Urry 2000: 35). The power of these network systems vis-à-vis human agents are related to the size of the networks, their density, their relations to other networks, and so on. As 'large socio-technical-systems' these networks display dynamics that are described in terms of 'path-dependencies', 'lock-in-factors', 'sunk-costs', momentum, iteration and other concepts that figure prominently in the sociology of (large) technological systems. With that, Urry's sociology of flows leans heavily towards systems theory, with a moderate role for human agency and with nonhuman actants getting actors qualities.[8]

The relevant innovations of the sociology of networks and flows for the social sciences of environmental reform are fourfold. First, with the introduction by Castells of the space of flows, and contrasting it with the space of place, a new kind of time-space organisation of practices is introduced that takes globalisation fully into account. Globalisation is no longer simply understood as elevating the same processes on a higher level. Second, the sociology of networks and flows lifts the sharp distinction between the social and the material world, between flows of information and money and flows of material substance, between the institutional infrastructure and the technological-material infrastructures. Within the sociology of networks and flows it is especially John Urry who – relying heavily on the actor-network theories of Latour (1987) and Callon (1980, 1987) and on the reinterpretation of these by Mol and Law (1994) – tries to overcome (or do away with) the dichotomy of the social and the material. In doing so, he goes way beyond the conventional schemes of environmental social scientists, who generally speaking remain comfortable with asserting that social systems should be seen as systems having a material base and with the recognition that material conditions do matter for social practices and institutional developments. Hybrids, actants, and sociotechnical systems are the key concepts that point to and analyse the fading dichotomy between the social and the material. Third, the strong separation between the conventional categories of state, market, and civil society is lifted, in favour of all kind of new emerging hybrid arrangements in-between. Networks and flows, scapes, and sociomaterial infrastructures, they all can no longer be understood in terms of state and markets. Hence, a new conceptualisation invades the social sciences. Fourth, ideas of governance, management, and control drastically change following the sociology of flows. Especially in Urry's notion of global fluids, but also in more

[8] Here, Urry comes close and refers to the French work on actor-network theory by Callon and Latour. In his more recent work, Latour (2004) seems more interested in, or at least pay lip service to, ecological questions.

general ideas of nation-states losing their sovereignty and power, possibilities of governance and control are seriously questioned. Within Urry's (2003) work this is related to the emergence of complexity and the disappearance of agency, against the background of a strongly system theoretical framework.

An Environmental Sociology of Networks and Flows

In applying the sociology of networks and flows for understanding twenty-first-century environmental reform, and thus to build an environmental sociology (or social theory) of networks and flows, we cannot just rely on the work of Castells, Urry, and other general – nonenvironmental – sociologists/social theorists. Their inclusion of environment in social theory is, at best, marginal (cf. Mol and Spaargaren 2006). And, to some extent, this new social theory of networks and flows runs counter to the same frictions environmental sociologists had with earlier social theories (as was so strongly articulated in the HEP-NEP debate; Catton and Dunlap 1978a, b). So, in applying insights from the sociology of networks and flows for a third generation social theory of environmental reform, we will combine the sociology of networks and flows with earlier contributions in the social sciences of environmental reform, most notably ecological modernisation perspectives.

Whereas most of the flow literature in the social sciences emphasises flows of capital, money, images, information, and people (travel and migration) and analyse them from perspectives as diverse as economic development, governance and control, cultural diversity, or democracy, an environmental sociology of flows focuses on an explicitly environmental interpretation of the flow concept. This environmental interpretation differs in two ways from the sociology of flows: (a) by analysing flows of information, capital, goods and persons from an ecological rationality point of view (by looking at environmental information, green products, green investment funds, sustainable management concepts, environmental certifications schemes, flows of environmental activists, and their ideas); and (b) by analysing environmental flows as such, that is: energy, water, waste, biodiversity, natural resources, contaminants, and the like. Neither Castells and Urry, nor any of the other social theorists in this tradition, developed so far an in-depth account of environmental change in any of the two ways. Environmental flows are mentioned in between all other kinds of 'flows' that could become or are object of sociological analyses. And these other flows are not assessed for their role in and (potential) contribution to environmental governance, deterioration, or reform. Nowhere, however, these authors argue that the set of material flows as commonly addressed within the environmental sciences and social sciences would deserve special social science reflection. Clouds, information, capital, people, or wastes are analysed, conceptualised, and understood in similar ways. The question is whether that is helpful for a full understanding of environmental reform. I think we are in need of a more specific *environmental* social theory of networks and flows, which builds on such general conceptualisations but specify them for environmental networks and flows. Such a specific environmental emphasis and substantiation also might reflect on and contribute to this emerging general sociology of networks and flows, perhaps stronger in the substantive formulation than in the formal social theory/concepts.

In relating environment to (global) networks and flows – both in terms of environmental flows as well as in terms of 'conventional' flows – conceptual space for new forms of environmental reform is constructed. Not unlike most political economists and neo-Marxist environmental social scientists, Castells discusses inequalities and power in relation to the environment primarily in the context of a rather straightforward dichotomy: place-bounded environmental movements attempt to resist the omnipotent actors of the space of (economic) flows. The environment or nature enters into Castells' analysis mainly as negative side-effects of the space of flows. In the end, Castells's view of environment and nature comes close to being but a reformulation of the conventional point of view of environmental economics ('externalities') in combination with the traditional 'protest-approach' in environmental sociology (social movements organising resistance against modernity, as we saw in the first generation of the social sciences of environmental reform). Castells (2004) does make room for a globalised environmental movement that locates and operates networks of protest at least partly in the space of flows (e.g., the anti-globalisation or other-globalisation movement), be it that their power to constitute and handle the switches, programmes, and codes that make a difference in the network society is marginal. Overall, within Castells's framework there seems to be limited room for including environment and environmental reform within the time-space dynamics of the space of flows itself. Sassen (2006) gives much more credit to global environmental NGO networks as constructive parts of what she calls the global assemblage. This global environmental movement constructs a new kind of authority, which is part and parcel of the global network society. This comes much closer to ecological modernisation scholars. In their debates with political economy scholars, ecological modernisation scholars have made conceptual space for the inclusion of environmental ideas, rationalities, and interests in the dominant economic practices and processes. In a more or less similar way, in the social theory of networks and flows environment and environmental protection should be articulated and conceptualised in the space of place as well as in the space of flow. Place-bound environmental resistance and protection by local NGOs and communities are sided by articulation of the environment in international trade, in Foreign Direct Investments, in global certification schemes such as ISO 14000 or Forest Stewardship Council labels, in transnational company networks, in worldwide epistemic communities (such as those around water or climate change), and so on. By interpreting environment and nature as attached to (also) the 'space of flows' rather than seeing them only or primarily as part of the 'space of place', questions and analyses of environmental governance and reform move beyond a defensive position of only 'blaming' intrusions and infringements of global networks and flows on the environment of local places. The 'space of flows' then becomes a relevant analytical category for protecting and articulating nature and environment, opening up sets of new scapes, networks, nodes, and strategies for environmental reform.

Double Hybridisation

Although the ecological modernisation school of thought already paved the way for less conventional interpretations of the role of political, economic, and civil society actors in environmental reform, this is further radicalised in the environmental sociology of networks and flows. Following the (global) governance literature, the state becomes increasingly replaced by a proliferation of governance arrangements that create new forms, institutions, and networks for governing actors' behaviour. This transition from government to governance is based on the understanding that the political is not limited to the traditional concept of the state, in the sense of a delineated institution. Transformations of the state, new alliances between the state and other actors, new state-market configurations, and the state as only one of the many elements of global networks form all new foci of theoretical attention in the governance literature.

In understanding environmental reform from such a new perspective (or social theory) conventional conceptual and theoretical categories and boundaries are challenged. The classical distinctions among state, market, and civil society actors and institutions are increasingly mixed up or blurred in dealing with environmental flows. For instance, when transnational companies with a proactive environmental strategy are working in a 'low-governance-arena' (e.g., sub-Saharan Africa), they sometimes come to act as government-like agents, regulating flows from a broader than just an economic perspective. We then can see market-actors behaving like states. But it happens also the other way around: states buying and selling 'sinks' on international markets, competing for 'green product-flows' and rationalising their green-energy politics from a liberalisation and privatisation point of view. Finally, the sharp divisions between markets and states with their system-rationalities, on the one hand, and civil society with its broader rationality, on the other (Habermas 1981), also seem to have lost some of their significance. Civil society actors are working increasingly (also) within – and thus become parts of – the 'official' system. Here we can see environmental NGOs acting as multinational companies, trading in environmental liability or credibility (World Wide Fund for Nature WWF), and actively creating 'sub-political arrangements' in direct negotiations between NGOs and market-actors (see, for instance, Pattberg 2005; Oosterveer 2007). Sometimes non-state actors fill the gaps, which are left open by state or market institutions that cannot keep up with the forces of globalisation (e.g., in nature conservation in developing countries; in eco-labelling of wood and fish products). Consequently, such forms of hybridisation show significant continuities with (and sometimes further radicalisations of) the notions of political modernisation, regulatory reinvention, and subpolitics, which prevailed in the second generation of environmental reform studies.

The environmental sociology of networks and flows emphasises and conceptualises such shifting boundaries and pays special attention to *hybrid arrangements* in the field of (global) environmental reform. Such arrangements can be interpreted in terms of specific combinations of global networks and scapes, around particular environmental flows. The relevant questions are of course where and when do we see, expect, need, or want these kinds of hybrid arrangements, what are the network and scape characteristics of these arrangements (for instance, in terms of infrastructures, power, inclusion and exclusion), how these hybrid arrangements are related to globalisation, and what the consequences are of such arrangements for governing environmental flows in terms of, for instance, environmental effectiveness and democracy.

There is, however, a second manner in which hybridisation makes sense in the context the environmental sociology of flows. With John Urry, one can argue that in sociology one of the most commonly used and cherished dichotomy, that of the social and the material, needs to be reconsidered and reformulated. In the tradition of Callon and Latour and the by now well-established Actor Network Theory (ANT) school, Urry criticises mainstream sociology – especially the structuration theory of Anthony Giddens – for overemphasising agency over (technological) structure in this respect. When, for example, the car-system is at (environmental) stake, the best way to make sense of the future development of this system is to conceive of it as a *hybrid system*, as a system in which material and social entities can no longer be separated in a meaningful way.

This challenging view could perhaps be neglected when working in thoroughly social fields such as labour relations, schooling or gender; but not when working in the environmental field. Since its inception, *environmental* sociology and other environmental social sciences have been struggling with society-nature/social-material interactions and the ways in which these interactions could best be conceptualised. Schnaiberg (1980) is exemplary in his arguments against the partial or total fusion of the material/natural and the social, because the social – according to Schnaiberg – is fundamentally different from the natural. Societies are "dependent from" the sets of ecosystems they rely on for their proper functioning, but they do not function in the same (mechanistic) ways ecosystems do. Because the social is different from the natural, the sciences of ecology and sociology also should be kept separate, so Schnaiberg argued. Sociology – or the social sciences in general – should not become mixed up with ecology or the natural sciences. This plea for separate tasks and identities of the social and the natural sciences also can be found in Anthony Giddens structuration theory: "those looking for natural science-based laws and explanations in the social sciences did not just pick the wrong platform, but were also waiting for a train that is never going to arrive" (Giddens 1976).

With the arrival of the sociology of networks and flows, the ongoing debate in environmental sociology on the relationship between the social and the material has taken a new direction and radicalised. John Urry – also following Ulrich Beck in this respect – argues that some of the well-defined 'units of analyses' so frequently used in contemporary sociology, turn out to be valid only in relation to societies of the first or 'simple modernity' phase of development. Key-concepts such as 'nation-state' or 'environment' – when used under conditions of second, reflexive, or global modernity – seem to have lost most of their validity. The concept of environment or nature during second modernity can no longer be used in isolation from society, because nature or environment is 'pulled into society', as much as society is ‘pulled into nature’. The concept of nature as external to society is outdated. According to Beck, only when it is recognised that society and environment in reflexive modernity are intermingled in many diverging ways, one can make sense of the (world) risk-society as emerging right under our eyes. The carcinogenic colouring agents in child toys, bird flu risks in your food, and climate change all give proof of the outdated character (or at least the limited usefulness) of the sociological concept of ‘nature’ in isolation from social practices, networks, institutions, and agents.

Power and Inequality

Finally, the social theory of networks and flows changes conceptualisations of power and inequality. Within the social theory of networks and flows, power and inequality are no longer only related to ownership of capital, as has been the dominant view in neo-Marxist studies, nor to the state, as was the mainstream conviction in most other schools of thought. In addition to these ‘conventional’ categories of power and inequality, the sociology of flows defines new inequalities in terms of having access to, being included in or being decoupled from, the key networks and flows. Groups, persons, cities, and regions with access to the core flows and located in or close to the central nodes and moorings of global networks, are the wealthy and powerful. Following Rifkin (2000), it is access to the information flows via the Internet, to the flows of monetary capital and to the skills of people moving around the world, that distinguishes the better-off people, groups, cities, and regions from their marginalised equivalents. This ‘access to’ and ‘inclusion in’ concerns both direct access and inclusion as well as the ability and capability to structure the scapes and infrastructures to partially influence the mobile flows in terms of speed, direction, intensity, and so on. Or, as Castells (2004) puts it: who has the power and capability to handle the switches between and the programmes of the networks that matter?

In following this analytical path, an environmental sociology of networks and flows perspective has two operationalisations of power and inequality. First, it pays attention to the conditions for access to environmental flows and to the scapes and networks that structure the current of strategic environmental flows. And it analyses in some detail the consequences for groups, actors, and organisations to whom access is denied or who do not manage to establish links with the relevant global networks. Such an operationalisation would reorient conventional environmental flow studies in directions very different from the current dominant natural science perspective on flow (e.g., material flow analysis, industrial ecology, etc.). It also would enrich present additions-and-withdrawals studies, as power and inequality are being linked to flows in a more direct way (see the discussion in Mol and Spaargaren 2005). Power is thought to reside in the ‘additions and withdrawals’ themselves, and not only in the social practices of production and consumption.

Second, power and inequality in an environmental sociology of flow perspective also would relate to the flows of capital, information, images, and persons that structure, condition and enable environmental reforms. The power and inequalities related to non-environmental and nonmaterial flows affect environmental reform trajectories. Those with access to and in (partial) control of the key economic and informational flows can be said to dominate the new networked world order, at the expense of the place-bound local actors outside the core nodes of the global networks.

Epilogue

Our theoretical elucidation on third generation 'social theories' of environmental reform has remained far from a systematic, coherent theory. We are only just starting to understand what environmental reform means in a global networked society and how and where such environmental reform processes differ from second generation environmental reforms. Some of the concepts, ideas and perspectives on environmental reform of the first and second generation will remain valid and useful under conditions of global modernity, where networks and flows seem to become increasingly important constituting parts. But the sociology of networks and flows, in its various forms and variants, teaches us that environmental reform – among many other things – will not remain unchanged following globalisation dynamics. Our elaborations above give at least an idea along which lines one can start thinking in developing new perspectives or social theories of environmental reform that fit the new social constellation. But much theoretical work and debate needs to be done before we will see the emergence of a more or less coherent theory of environmental reform in networked global modernity.

Of course, in developing such new theoretical insights empirical studies are essential. Slowly, empirical studies are being developed using an environmental sociology of networks and flow perspective for understanding environmental reform (cf. various contributions in Spaargaren et al. 2006; Oosterveer 2007; Bush and Oosterveer 2007; Mol 2007). This is not the place to review these empirical studies; others will definitely do so.

One of the subjects in the theoretical and empirical debates and discussions emerging will without doubt be related to the necessity of a new theory and the continuing validity of the first and second generation environmental reform explanatory theories. These validity claims are correct. Ecological modernisation theory remains to a major extent valid, and so do the policy and protest theories of the first generation. In a considerable number of cases these models will be very helpful in explaining and understanding environmental reform in the twenty-first century. But in a number of cases and contexts – and most likely an increasing number – we are in need of new theories, along lines of an environmental sociology of networks and flows.

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Chapter 3
The New Climate Change Discourse: A Challenge for Environmental Sociology

Fritz Reusswig

Abstract The chapter gives an analysis of the shifting social discourse on climate change in Germany and the U.S. Climate Change Discourses (CCD) are defined as thematically focused coupled sequences of arguments that different social actors use in order to influence one another or their social contexts in order to improve the chances of their resource endowments, interests, and worldviews to prevail in collective decision making processes. The major change in the recent CCD is seen as a shift from a framework of understanding the Earth System to a framework of decision making under uncertainties. The traditional (and in part ideological) opposition of mitigation and adaptation policies will have give way to an optimal mix of both. The chapter gives empirical evidence for that analysis from mass media coverage, public opinion, policy making, and the business sector. This shift occurs currently more markedly in Germany than in the U.S., will probably catch up across the Atlantic soon. The final section sketches the outlines of a low-carbon society and discusses some major challenges to environmental sociology such as more systemic views, active engagement in IPCC's working group III, risk analysis of climate solutions, critical assessments of socio-technical experiments.

Keywords Global climate change • Climate change discourse • Mass media • Uncertainty • Public sociology

Introduction

In 2007 the Peace Nobel Committee dedicated its annual award to the Intergovernmental Panel on Climate Change (IPCC), and to U.S. politician Al Gore. This split nomination encompasses in a nutshell two ends of a wide-ranging social

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discourse on climate change, and it indicates at the same time how publicly visible and relevant climate change as a global environmental problem has become for political agenda setting.

In this chapter I will try to give evidence to the thesis that this act of public visibility goes beyond pure symbolic politics, and that what I will term the social discourse on climate change has experienced a significant shift – not only in intensity, but also in content and functional embeddedness. What we have observed – both in Europe and in the U.S. – is more indicative for a discourse shift that is part of a broader social transformation: the coming about of a post-carbon (or low carbon) society, affecting both the material and the symbolic 'fabric' of modern societies. The study of the processes, actors, and possibly contradicting socio-ecological outcomes of such a society should become a major focus of environmental sociology in the future. I will argue that addressing the issues associated with this transformation will require a reconfiguration of environmental sociology as we know it. Some of the theoretical and empirical assets that this not-exactly-disciplinary sub-discipline has accumulated during the past 40 or so years can help us to better understand what is going on in human-nature interactions, while others, as I will argue, need to be transformed or even abandoned altogether.

Given the significant rise in mass media resonance of the climate change issue in 2007, one might be tempted to attribute it to internal cycles of mass media and/or public attention exclusively. I will argue that this is not the case and try to illustrate the thesis of a discourse shift with examples from Germany (Section on "A Short Look at the U.S. Case") and the U.S. (Section on "The Emergence of a Post-Carbon Society and the Challenges to Environmental Sociology").

In my sociological analysis, discourses are situated (or embedded) in social dynamics, which at the same time they articulate and frame. Social change is embedded discourse. The discourse shifts in 2007 will thus be embedded in a wider framework of a social transformation with regard to human-nature interactions: the emergence of a post-carbon (or low-carbon) society. Given this embedded view, I will in the fourth and last section give an assessment of environmental sociology's capability to deal with the new developments.

The Shifting Climate Change Discourse in Germany

The main thesis of this chapter is that we are witnessing a qualitative change of the Climate Change Discourse in modern societies, with Germany as a forerunner, and the U.S. as a follower. Before analyzing this shift for both countries, I would like to briefly indicate what I understand by 'Climate Change Discourse'.

A Climate Change Discourse (CCD) is a *thematically focused* and (more or less) *coupled* sequence of *publicly visible arguments* in various *contexts* (or *framings*) that different social actors are engaged in, in order to *influence* (a) *one another*, (b) specific *boundary conditions* of social action, (c) the *general public* so, that the resource endowments, interests and worldviews of the speaking actors have a higher *chance* to *prevail* in the social *interpretation* and individual or collective *decision making processes*.

This definition combines classical elements of the Foucault tradition of discourse analysis, but combines it with an actor and systems perspective from sociology. It is inspired by the Critical Discourse Analysis (CDA) as has been put forward by Fairclough (1992, 1995) as an attempt to synthesize linguistic and social approaches of discourse analysis.[1] Discourse analysis can be seen as a contemporary realization of Max Weber's dictum that social reality is driven (and to some degree even constituted by) 'ideas' *and* 'interests' alike, not by either one of them exclusively. Or, put differently, a discourse "is about language *and* practice" (Hall 2005: 44).

In this section, I will sketch the shift of CCD in Germany, before I will try to apply the emerging pattern to the U.S. context. The evidence base for this analysis is, due to the complex nature of CCDs in modern societies in general, a heterogeneous one: mass media documents, internet sources, books, papers in scientific journals, political and business statements, etc. The distinction between 'old' and 'new' CCD is not the result of a broad analysis in the first place, but came as an intuitive impression first, before I tried to materialize it in a more systematic way. As in social reality characteristics and changes usually are less clear cut, but more gradual, I would like to understand the distinction between old and new CCD as an ideal type in Max Weber's sense.[2] One can summarize the changing CCD with Table 3.1.

It is not easy to identify when the 'old' CCD has in fact started. The discovery of the greenhouse effect dates back to the nineteenth century, with scientific pioneers like Arrhenius or Tyndall as the main or in fact only social factors involved (Weart 2003). I would date back the origin of the 'old' CCD to the late 1970s/early 1980s, when (a) the mass media started to cover the issue, and (b) political actors took it on. Clearly, the formation of the Intergovernmental Panel on Climate Change (IPCC) by the United Nations Environmental Program (UNEP) and the World Meteorological Organization (WMO) in 1988 marked a substantial consolidation of the 'old' CCD. From now on, climate science did have a social organization, located in the UN system, with formalized tasks and opportunities to feed in the stream of scientific knowledge (based on peer reviews) into the political system and the public debate. Given the high degree of uncertainties with regard to the complex interactions of the climate system with the other components of the Earth System (e.g., biosphere,

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[1]Keller (2005) offers an enlightening discussion of the sociological and philosophical backgrounds of modern discourse analysis, and gives some applications to debates about environmental risk. Stamou and Paraskevopoulos (2004) have analyzed images of nature in the nature tourism sector. Ereaut and Segnit (2006) have analyzed the recent British CCD in an interesting manner, but narrowed down 'discourse' to mass media coverage. Viehöver (2003) has also looked at the ('old') climate discourse, but in a broader way. Discourse analysis can highlight the embedded and contextual nature of global environmental issues, and the "constitutive role of discourses" in shaping identities and attitudes (Macnaghten and Urry 1998).

[2]This is why they usually appear in quotation marks.

Table 3.1 Old and new climate change discourse

Dimension	Old climate change discourse	New climate change discourse
Master frame	Understanding (explaining) the earth system	Decision making under uncertainty
Leading sciences	Physics, climatology, other natural sciences (▶IPCC Working Group I)	Economics, engineering, other social sciences (▶IPCC Working Group III)
Risk concept	Climate impact risks	Socio-climatic action risks
Core question*s*	Is there (anthropogenic) CC? How certain can we be about it? How and when will natural and social systems be affected?	What is dangerous CC? How can a cost effective and fair stabilization of the climate system be achieved? What is an optimal degree of adaptation, and how can it be financed?
Main actors	Natural sciences, environmental politics, environmental movement	Trans-disciplinary science, politics in general, business sector, environmental movement, critical consumers
Core public debates	Alarmism versus skepticism	Cost-benefit analysis vs. portfolio management
	Mitigation versus adaptation	Optimal mix of mitigation/adaptation
		Market vs. social/political solutions

oceans, and cryosphere), a major task of the ‘old’ CCD was to consolidate the major (causal) systems relations, and to quantify the respective flows and effects. As already available paleo-climatologic data had already demonstrated, the Earth’s climate had experienced substantial changes in prehistoric times. The most important question for the ‘old’ CCD was thus to find out if and to what degree human activities did cause observed recent climate change. The search for such a ‘fingerprint’ is difficult, not only for reasons of internal complexity, but for more structural reasons of detecting causation in multi-effect systems in general.

The master frame of this early stage was thus one of ‘understanding the Earth System’, or more precisely: explaining major observed effects by tracing them back to complex causal patterns. Although IPCC did have three Working Groups right from its beginning, Working Group (WG) I did take the lead in the ‘old’ CCD. WG I members typically are atmospheric scientists, climatologists, physicists, chemists, or Earth System modelers. The examples of Galileo, Newton or Einstein illustrate how physics did play a leading role in the evolution of modern science, and that physicists have often been endowed with a consciousness of forming the top end of scientific discovery. This is one reason why the more physics-oriented body of research reported in WG I assessments has been officially termed ‘The Scientific Basis’. Due to their higher complexity and lower degrees of predictability, biological systems seem to be less able to be conceived in a unified and consistent theoretical framework, based on first principles. It seems to us that this is the reason why biologists are perceived as being a little ‘less scientific’ than, say, physicists. As biologists (and geographers) make up the majority of WG II members, the results of this group do not count as 'scientifically basic' as WG I results. And this despite the fact that the scope of WG II, dealing with impacts of climate change and the vulnerability of biological and social systems, covers more or less the reasons for social concern about climate change: most social actors worry about the impacts of climate change, not about climate change 'as such'. WG III finally, dealing with mitigation options and adaptation to climate change, has many members from the social sciences, as well as some engineering an energy modeling people. Again, their work is very important if we consider that future climate change is heavily dependent upon future anthropogenic emissions and its social and technological drivers. But the scientific character of economics or sociology is disputed among 'hard core' scientists, may be even more so than the work of biologists and geographers. The least one can say is that for the core question of the 'old' CCD – is there anthropogenic climate change? – the social sciences did have little to contribute.

As difficult as it is to identify the beginning of the 'old' CCD, it is not easy to detect the emergence of a 'new' one. One indicator could be the quantitative coverage of climate change (sometimes also referred to as Global Warming) in the mass media. Our own analysis of German and international press articles since 1997 – based upon the Potsdam Institute's internal collection of climate change related articles – reveals that the years 2006/2007 show a clear increase in coverage. Several other indicators support the assumption of a qualitative shift in public discourse. For example, the leading conservative daily newspaper *Frankfurt Allgemeine Zeitung* (FAZ), traditionally an advocate of a more skeptical stance to climate change, redefined its position and launched an extra section on climate change, with many original contributions from climate scientists. The title page of the popular weekly magazine *Stern* was colored green (instead of red, as usual) and had the title line "How we can save the world – and have a nice living nevertheless."

In 2004, a Hollywood movie (*The Day After Tomorrow*) addressed climate change in a disaster movie style – and inaugurated a new box office category ("Global Warming Movies") (Reusswig et al. 2004). In 2006, the former U.S. vice president Al Gore managed to produce and launch a semi-documentary movie on the science of global warming – and was awarded the peace Nobel prize in 2007. Later that year, the British economist Sir Nicholas Stern did publish a collaborative study on the economical aspects of climate change, arguing that the monetary costs of climate change would by far outweigh the costs of climate protection (Stern 2007). In 2007, the IPCC in a series of press conferences launched its Fourth Assessment Report, stating that the debate about whether or not humans would cause climate change was over and vigorously asking for immediate action to reduce GHG emissions.

These events indicate an intensified CCD. But what structural changes would justify the thesis of a discourse shift? The first striking point is that climate change has become part of popular culture and everyday life. Be it in a more Science-Fiction manner (as in *The Day After Tomorrow*), or in a more popular science manner (as in *An Inconvenient Truth* or in many background stories of newspapers and magazines), climate change has reached the masses in modern societies. As mass media *coverage* does not directly tell something about its social *impacts* (or resonance), one needs additional data in order to support this claim. The AC Nielsen Global Survey on Climate Change (2007) is a helpful source here. Carried out in October 2006 and in April 2007, the study reveals a significant increase in concern about global warming and in the perceived necessity to act against it.

These global average values from 47 countries are astonishing in some respect. Concern about global warming did outpace terrorism, political stability, crime, war and immigration in only 6 months – issues that did concern people (much) more in 2006. Still global warming cannot compete with economic or health issues, but given the fact that health and jobs affect people immediately, whereas global warming is a somehow 'distant' issue, the upturn in concern is remarkable.[3] For the vast majority of people, the mass media are the main source for information about climate change and climate policies. The upswing in global public concern about climate change is thus an indicator of increased mass media coverage and increased media impacts.

If we study the mass media coverage of global warming/climate change in more detail, we find that despite severe cases of alarmism in some tabloid newspapers (such as *BILD-Zeitung*) a rather neutral and matter-of-factly style of reporting dominates. The orientation towards the actual in mass media requires 'events' as hooks for both reporting and background analysis. The publication of the Stern Review in 2006, and more so of IPCC's Fourth Assessment Report had created these events. In addition, extreme weather events (such as the European heat wave in 2003, hurricane 'Katrina' in the U.S. in 2005, or the very mild European winter 2006/2007) did also serve as starting points for media reports on climate change.[4] And, finally, if the political system addresses climate change, the mass media will report on it immediately, as informing about and discussion of the policy system (decisions, effects, debates, persons, parties, …) lies at the very heart of the mass media. Even if the typical mass media opener 'new scientific discoveries reveal dramatic consequences', applied often during the publication of the IPCC's Fourth Assessment Report (2007), has vanished, the issue 'climate change' will remain a virulent potential source of mass media reports. Not only due to the fact that virtually every extreme weather event can from now on be attributed to indirect human causation (instead of purely natural reasons), but also because other important social systems – namely the political system and the economy – have started to internalize the issue, and to develop system-specific solutions.

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[3] The global average increase in concern for global warming was 9% (from 7 to 16). In Germany, this indicator increased from 7 to 19, in the U.S. from 6 to 13, in Italy from 3 to 17, and in France from 27 to 32.

[4] As weather is a more stochastically characterized system – in contrast to the more deterministically characterized climate system – direct inference from single weather extremes to climate change does not hold. However, if weather extremes display a tendency (such as an increase in heat waves of storm intensity) one can even statistically relate it to climate change.

Climate policy used to be a sub-domain of the environmental administration – supported or confronted by environmental NGOs. Under the auspices of the 'new' CCD we find that climate policy has experienced several shifts, or steps towards 'mainstreaming': (1) The environmental administration – in its own self-understanding still the political 'owner' of climate policy – has well perceived that competing actors at the government level have entered the field (see later). In part as a reaction to this, climate policy is now reframed by the ministry in various ways. First, increasing prices for oil and gas – always 'natural allies' for climate policies – support a framing towards energy security. Second, the ambitious GHG reduction targets of the government (see later) require substantial technological and organizational innovations in society, leading the ministry to act as a core agent of innovation and ecological industry policy. Third, increasing energy prices together with a rather new and successful political competitor (the Left party) have lead to a (still minor) reframing of climate policy as an area of environmental justice.[5] (2) Chancellor Angela Merkel – a physicist by training with experience as the German Minister of the Environment in the late 1990s – has taken on climate change as a top priority political issue.[6] One might argue: "But she did it for reasons of political power." This is most probably the case. However, the interesting point here is that for the first time a Chancellor assumes climate policy to be an area where political elections could be won. (3) Parallel to this upgrading process, climate change evolved as a cross-cutting policy issue of the federal government. In addition to what the environmental ministry is doing, other ministries in 2007 embarked on a process that can be described as a competition for who deals best with climate change. Screening homepages, brochures and programs of various federal ministries, one can, for example, observe how the ministry for research (BMBF) tries to frame climate change as a challenge for research and innovation – and to initiate programs and allocate funds in such a way that the own set of activities can be perceived as the key to a solution. The ministry of economic affairs (BMWi), to name another example, frames climate change as a problem of innovation and economic incentives, launching new initiatives and programs to turn the issue into a new business opportunity area. The same holds for other ministries. The total collective endeavor of the federal government to mitigate

[5] The environmental ministry is actually headed by a Social Democrat (Sigmar Gabriel). The Social Democratic Party (SPD) has come under pressure from the Left party (as a merger from former Democratic Socialists from the East, and left-wing Social Democrats from the West), and 'social justice' – which used to be a ancient SPD issue – has now become a contested political area. It seems as if environmental justice – an U.S. issue mainly related to the allocation of environmental bads to minority groups – is now emerging in the German context, and with new meanings (Schlüns 2007).

[6] This became clear during the 2007 G8 summit at Heiligendamm, where climate change was a major issue. She installed a small climate advisory group directly linked to her Chancellor office. And she publicly communicated the scientifically based idea of 'global carbon justice', i.e. the target of 2 t of GHG emissions per person in 2050, regardless where that person lives.

against the causes of climate change has been summarized in the so-called 'Meseberg package', i.e. a collection of political measures aiming at a reduction of German GHG emissions of 40% (against the 1990 level) by 2020.[7]

A final characteristic of the 'new' CCD is the fact that climate change has made its way to the business sector. Undoubtedly climate change has been a business case already in the days of the 'old' CCD. However, the number of companies that did profit from climate protection policies has been rather limited. One example would be the wind energy sector, i.e. the producers of wind turbines and related engineering, material and service providers. In 2004, almost 50,000 people were employed by this sector, 36% of which for export (Lehr et al. 2008). The industry is dominated by small and medium enterprises.

Once the political measures of the 'Meseberg package' are realized, the economic boundary conditions will change. According to a study (PIK/ISI 2008), the total investment to implement Meseberg until 2020 will amount to €13 billion (BMU 2008).[8] More and more large firms engage in climate protection and/or energy efficiency improvements. One example is the launch of a Product Carbon Footprint (PCF) Pilot Project in Germany in April 2008. A consortium of ten firms (e.g., *Henkel*, *Tchibo*, BASF, *dm* drug store markets, or *Frosta*) works together with four partners from science, the NGO world, and communication specialists (*Öko-Institut*, *PIK*, *WWF Germany*, *Thema 1*) in order to develop a sound and acceptable methodology of assessing the carbon footprint along the supply chain of consumer goods, and eventually to communicate the product carbon footprint to the end consumer, e.g., by a carbon label.[9] On average, every single German consumer is responsible for about 11 t of CO_{2eq} per year. Four tons (or 36%) are related to food, drinks, and other consumer goods. This is more than the building or travel related emissions respectively. PCFs will be a key instrument to raise consumer awareness, and to create carbon transparency in the domain of consumer goods which actually is either lacking – or distorted by single issue foci like on food miles exclusively.

Corporate Carbon Footprints (CCF) complement PCFs in accounting for the total GHG emissions from the activities of a corporation. They do not only address the end consumer and the general public, but also and primarily investors. The Carbon Disclosure Project (CDP) is an investment firm led initiative to seeks information on the business risks and opportunities presented by climate change and greenhouse gas emissions data from the world's largest companies: 3,000 in 2008, representing a total of $57 trillion of assets under management (http://www.cdproject.net/).

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[7] There is a parallel, but less ambitious goal at the European Union level. The German climate policy package is termed after a castle north of Berlin where a government conference first decided about the outlines of the program. Important parts of the program had taken all political hurdles early in 2008. Others are subject to negotiations, e.g., those relating to car fleet emissions.

[8] The total net investment sum of the German economy in 2005 was about €70 billion. Germany's net investment rate since the early 1990s has been very low compared to international standards.

[9] The carbon footprint includes six greenhouse gases. The use phase will not be assessed, as it resides with the consumer's behavior. In 2007, the British *Carbon Trust* had launched a CO_2 label, and *Tesco*, Britain's largest retailer, followed suit.

Climate change and climate solutions have evolved as a major domain of environmentally related Corporate Social Responsibility activities of firms (Epstein 2008; Laszlo 2008; Schaltegger and Wagner 2006). These also cover social issues, like abandoning child labor or guaranteeing fair working conditions for employees in the developing world.

Once the major questions of the 'old' CCD have been answered positively ("Yes, there is climate change; yes, humans are substantially contributing to it, and yes, the net effects of climate change will be negative and severe"), the discourse framing can shift from analysis to action (solution). Despite its purely scientific role at the science-policy interface, the IPCC in the public presentation of its Fourth Assessment Report contributed a lot to this shift.[10] The message conveyed was unambiguous and clear, as well as appeal to policy makers to act. It has been argued convincingly that scientific consensus in the climate domain is no necessary prerequisite for political action (Grundmann 2006, 2007). However, the public appearance of IPCC in 2007 did in fact create the image of such a consensus. In addition, the IPCC members seemed to share a common understanding of the problem, and a moral intuition that immediate action was necessary. With its 2007 report (at least as presented to the mass media), the IPCC for the first time acted as an 'epistemic community' (Haas 1992).

The master frame of the 'new' CCD is decision making under uncertainty. Uncertainties did of course play a crucial role in the 'old' CCD as well. But here the dominant uncertainties have been associated with aspects of the (natural) Earth System, and with the models and data used to analyze it and generate future scenarios. In the 'new' CCD, major uncertainties flow from the nature of human decision making. They refer to the double contingency of social interaction, the inherent future orientation of decisions, and the internal dynamics of technological, economic, and political systems.

Under a decision making master frame, the future energy prices are very important for actual behavior, such as investment in energy related infrastructure and machines (e.g., car engines). The recent high level of fossil fuel prices is supporting a discourse shift. But new uncertainties arise, as modern societies are complex and interdependent dynamical units. The mutual interdependence between the future car engine technology (hybrids, electric cars, hydrogen cars …?) and the future fuel provisioning system (bio-fuels, hydrogen, electricity …?). Both questions are clearly interrelated, but car manufacturers, oil companies, and consumers do not harmonize their respective investment and strategies in advance. Rather, they co-evolve in a process of mutual observation, combined with try and error.

One of the major impulses for 'mainstreaming' climate change was the key message from the Stern Review that climate protection policies will not, as previously

[10] At the press conferences, IPCC scientists – and especially Randra Pachauri, IPCC's chair – did take the opportunity to take one step away from the official and rather neutral language of the report, and acted as interpreters of their own results. This has led some critical observers to conclude that IPCC was supporting alarmism (Hulme 2006). A more thorough interpretation of the latest trends in the scientific CCD, however, reveals that an alarming language is consistent with recent findings and inherent uncertainties (Risbey 2008, cf. Walker and King 2008).

assumed by many climate economic models, be associated with prohibitively high costs. Consequent mitigation strategies will cost only about 1% of the global Gross Domestic Product (GDP) (Stern 2007). Critics of Stern argue that, among other things, this rather optimistic assessment critically depends upon the discount rate with which we weigh the present value of future damages (Tol 2006). As this rate expresses moral choices of economic actors (and not of scientists), it cannot be assumed as an exogenous parameter, but emerges from within the economic system as an empirical data. In any case, the Stern Review has first translated the climate problem into the 'language' of the economic system, which was a necessary, but not a sufficient condition for its success. In addition, Stern applied standard cost-benefit analysis and calculated that resolute climate policy would pay off already today.[11]

While the 'old' CCD focused on climate impact risks, i.e. the probability of climate system related damages to natural and social systems, the 'new' CCD deals with a much more complex notion of risks (Jaeger et al. 2001; Renn in this volume). Climate impact risks remain important, but become now embedded in decision making processes at many levels – decision making processes that in turn influence the character of climate risks. Questions like: "How much will it cost to take action now, how much emission reductions will that bring, what concentration levels do arise from that, what temperature changes will this cause, and what damages (or damage reductions) will then occur as a consequence of (in)action?" dominate the scene. As there is no such thing as 'the human decision maker', but only a multitude of decision making individuals and organizations, the question mentioned translates into social conflicts about who has to bear the costs of climate policy – or will profit from it.[12]

It would thus be all too naïve to assume that the decision making framework of the 'new' CCD resulted in a social situation of unanimous 'ideas and interests' (Max Weber) supportive of consistent mitigation efforts. Quite the opposite: mitigation policies do have the potential to harm social interests substantially, such as declaring that the traditional, fossil fuel based technological infrastructure of modern societies simply represents a severe (climate system mediated) risk – not only to remote or future generations, but also to neighbors and friends.[13] And the scientific climate discourse plays a key role in doing so by providing reliable arguments in case. For decades, the burning of oil and coal was not associated with global

[11] Egner (2007) uses a Luhman approach and argues that the first (necessary) condition would also be a sufficient one. Her analysis suffers not only from the empirical weaknesses of Luhmann's 'thin descriptions' of the modern economy (for a better one see Beckert 2007). It also ignores that climate economists *preceding* Stern's Review did conclude exactly the opposite. Climate protection was assumed to be too expensive (Nordhaus 2007).

[12] The economic 'think tank' of Germany's Deutsche Bank has identified winner and loser branches of both climate change and climate policy. The renewable energy as well as the construction sector are evaluated as 'double winners', while the fossil energy or the traffic sector are seen as 'double losers' (DB Research 2007).

[13] The European summer heat wave of 2003 has led to about 70,000 additional deaths. It can be demonstrated statistically that it is much more plausible to assume that this singular weather extreme event has been a consequence of anthropogenic climate change than to assume that it was a 'normal accident' under the historic climate regime (Beniston and Diaz 2004).

environmental risks. Once the hypothesis of anthropogenic climate change has become a scientific fact, oil and coal transform into hazardous substances. Whoever owns oil and coal stocks is now confronted with the possibility that the future profitable exploitation of these stocks in terms of natural rents or taxes will no longer be possible. The stock market value of such companies (or state monopolies) may fall drastically. If, on the other hand, market participants realize that a climate policy measure would serve the interests of a particular branch or firm (i.e. if their expectations change), then stock market values will grow – and, in turn, the capital flow of the respective firms.

A final word to mitigation and adaptation; the ‘old’ CCD was characterized by a quite fierce opposition of both, not only for ideological reasons (adapting was equaled to ‘giving up’), but also due to uncertainties with regard to the expected future climate impacts. After 2 decades of IPCC (and underlying scientific work), our understanding of the Earth System is sufficient enough to sketch out what will most probably happen. We know by now, for example, that even a complete reduction of greenhouse gas emissions to zero today would – due to system inertias – neither lead to an immediate stabilization of atmospheric GHG concentrations, nor to a new equilibrium Global Mean Temperature (GMT) at 2008 levels. Instead, given the past emissions until 2008, the climate system will respond with additional 0.6°C of global warming – which adds to the 0.8°C we have already measured against the pre-industrial value. In other words: adaptation is necessary anyway, even if mitigation will be successful. The new aspect today is that the mutual exclusiveness of both policy options has given room to a search for optimal mixes between the two. As public and private funds are limited, no decision making unit can afford to optimize both options independently of one another.

In Germany, adaptation to climate change has been dealt with rather reluctantly in recent years, compared to, say, the British or the Dutch debates. However, based upon comprehensive studies about climate change impacts on German agriculture, coasts, rivers, water availability, public health, etc. (Zebisch et al. 2005), the Federal Environment Protection Agency (UBA) has launched an adaptation competence center (*KomPass*) that deals with the related issues (http://www.anpassung.net). Some Länder (e.g., Sachsen) have started to prepare the vulnerable communities via public hearings and other forms of communication.

As misleading as it would be to focus on mitigation without adaptation, the mistaken one would be to concentrate all efforts on adaptation, and leave emissions unchecked. Proponents of such an ‘adaptation only’ strategy neglect the fact that it makes a huge difference to what future climate we do adapt today. If the world society manages to stabilize GMT at the often proposed 2°C goal, many severe (if not disastrous) effects will most probably be avoided – although there are also uncertainties involved in this statement (den Elzen et al. 2007). But if global mitigation endeavors fail, we will probably be confronted with 4–6°C warmer world.[14]

[14] It is worth noting that the GMT difference between the 1960–1990 climate and the last ice age was about 4–6°C – only in the other direction. Relatively small average temperature changes mask major changes in the state of the Earth System.

Sea levels could then rise about 50 m above present values – not even the famous Dutch engineers will then be able to protect the Netherland coastline.

To conclude this section one can summarize that both quantitative and qualitative analysis of the German situation can be stylized as the transition from 'old' to 'new' CCD. There are continuities as well, but one would miss important changes if the diagnosis stressed them exclusively.

A Short Look at the U.S. Case

Due to its outstanding scientific infrastructure, the U.S. has been a place where many discoveries have been made. NASA's satellites for example did play a core role in detecting the Ozone 'hole' during the 1980s. And its leading role in climate science – in part due to the military relevance of weather predictions – as well as in available computer power enabled the U.S. scientific community to contribute substantially to the evolution of climate science (Edwards 1999; Miller and Edwards 2001). Al Gore's documentary on climate change did do a lot for awareness raising on the issue both in- and outside America. The public understanding of science in the U.S. is growing continuously, and the public belief in the value of scientific research for economic prosperity and for the quality of life remains high (Miller 2004).

However, climate change has been discussed much more controversial at the political level in the U.S. than in most European countries. One of the reasons could be that the U.S. not only is a major importer of oil and gas, but also is a major producer of these two fossil fuels – and home to powerful oil and gas corporations. The 1994 Republican takeover of Congress created a political opportunity space that enabled these interests – armed with quasi-scientific arguments from conservative 'think tanks' – to establish a fierce climate 'skepticism' at the federal level. This controversial framing had been reinforced by two political events: first, the presidency of George W. Bush, and second, the substantial shift in political attention towards the 'war on terrorism' after the 9/11 attacks (McCright and Dunlap 2003). Since then, it has been virtually impossible to think of any regulatory approach to cut GHG emissions – not at the national ('red tape'), but definitely not at the international level (abhorring a 'UN rules the U.S.' *bête noire*). It was this discourse constellation that devaluated even promising aspects of the official U.S. position towards the development of the international climate policy regime, for which the Kyoto Protocol is an abbreviation.[15]

The controversial framing of climate change in the U.S. did have the – paradoxical – effect that today more Americans (59%) than Germans (28%) have heard 'a great deal' about climate change. But only 71% of U.S. citizens believe that

[15] The claim that big and growing developing countries like India and China would have to enter a binding agreement on emissions reductions, for example, is a reasonable one. Nevertheless the Bush administration lost its credibility to developing countries due to its unwillingness to accept such obligations, and to start reducing immediately, according to a contraction-and-convergence regime.

human activity is a significant cause of climate change, compared to 87% in Germany. The U.S. figure is comparable to the ones in Indonesia (71) and Kenya (72). More Americans (75%) than Germans (61%) believe that growing developing countries should limit their emissions along with industrialized ones; and slightly less Americans (70%) than Germans (75%) support the idea that the industrialized world should assist developing countries to cut their emissions (BBC 2007). These results may reflect the impact of the federal policy on the public opinion.

Leiserowitz (2003) has shown how climate change has been perceived by most Americans as an important, but also as a rather distant global issue. Climate change evokes images of melting ice caps and urban heat waves for the majority of U.S. citizens, but only a minority of environmental activists perceives it as a disaster – unlike in Germany, where the term '*Klimakatastrophe*' ('climate disaster') has become a key element in public communication (Weingart et al. 2007). While the mainstreaming of climate change seemed to be rather successful, it did not yet work out in the U.S. One reason might be that environmentalism in the U.S. was much more concerned with the demarcation of discourse coalitions, while German environmentalism has managed to enter the views of important fractions of the political system (Shellenberger and Nordhaus 2004).

In a similar direction hints the mass media coverage on climate change (or global warming) in the U.S. Boykoff and Boykoff (2004) have highlighted that the mass media coupling to the political system pre-disposes it towards a balanced view of controversial political issues, representing the government and the opposition point of view. Applied to the domain of climate science, this balanced view turns into a clear bias towards climate skepticism, as the vast majority of climate scientists do not doubt the anthropogenic causation of climate change. However, as Grundmann (2007) has shown, German mass media are far less prone to this bias, despite being programmed in quite the same manner towards a balanced view. The U.S. phenomenon of a substantial degree of climate skepticism in the mass media must thus not be attributed to an inherent property of the mass media system, but should at least as much be attributed to the more unfavorable political boundary conditions.

Although it is quite popular among European greens and intellectuals to criticize the U.S. because of its present administration, one must not underestimate the recent changes in the U.S. CCD. Mass media coverage of climate change did increase recently in the U.S. as well, although not as marked as in Europe (Boykoff 2007). At the same time, as a tribute to Hegel's 'cunning of reason', the climate policy stalemate at the federal level has led to various activities at the level of states and cities.

California's governor Arnold Schwarzenegger for example initiated a series of policy measures that aim at a substantial reduction of GHG emissions by 2050 (the Global Warming Solutions Act, or AB32, of 2006). The Californian government has set up incentives for alternative fuels as well as car and building codes. In addition, California is decided to establish a carbon emissions trading scheme, similar to Europe's ETS.

Already in 1997 the U.S. state of Oregon enacted the Oregon Standard, the first regulation of CO_2 in the U.S., requiring that new power plants built in Oregon reduce their CO_2 emissions to 17% below the most efficient combined cycle plant.

On the East Coast of the U.S., eight states are developing the Regional Greenhouse Gas Initiative (RGGI), a regional strategy to reduce carbon dioxide emissions utilizing a cap-and-trade system. The program commits participating states to cap their emissions at 1990 levels after 2009 and then drop them by 10% by 2018.

Richard Sandor, a former chief economist at the Chicago Board of Trade, launched 'North America's only voluntary, legally binding rules-based greenhouse gas emission reduction and trading system for six greenhouse gases' in 2003 (www.chicagoclimatex.com). He called the trading platform the Chicago Climate Exchange (CCX). The exchange refers to the carbon credits it trades as carbon financial instruments (CFIs, measured in tons of CO_{2e}) and restricts trading to members who have voluntarily signed up to its mandatory reductions policy (currently: reduce total emissions by 6% until 2010 below a 1998–2001 baseline). Since its launch in late 2003, CCX has grown in membership from 19 to over 100 (full) institutions, including partners like Ford Motor, IBM, American Electric Power, the City of Chicago, the City of Portland, the State of New Mexico, or Michigan State University. CCX traded 6.33 million tCO_{2e} in 2007 for a total value of US$13.3 million (CCX 2008).

In the business world, many U.S. corporations have started to first calculate and then reduce the Corporate Carbon Footprint. One example is Wal-Mart, the world's largest retailing company. Formerly known as anti-union, the corporation changed its position in 2005/06, and is now seeking to save energy and waste, and to reduce GHG emissions along the whole value chain.

There are signs that the American climate change discourse is in fact changing (Moser and Dilling 2008). The clearest sign recently has of course been the election of Barack Obama as President of the United States, which gave a new boost to both national and international climate policy initiatives. In a speech Obama said:

> So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity. (Obama 2009)

Dealing with the latest financial and economic crisis, the U.S. Government did release *The American Recovery and Reinvestment Act*, including more than US$60 billion in clean energy investments, aiming at a jump-start of the economy and the building of the clean energy jobs of the future. The Act provides $11 billion for a bigger, better, and smarter grid, as well as for 40 million smart meters to be deployed in American homes. It included $5 billion for low-income home weatherization projects, $4.5 billion to green federal buildings, $6.3 billion for state and local renewable energy and energy efficiency efforts, $600 million in green job training programs, and $2 billion in competitive grants to develop the next generation of batteries to store energy (White House 2009).

It remains to be seen whether the U.S. will also join international efforts as the Kyoto Protocol or successor solutions. The Conference of the Parties (COP) to the UNFCCC meeting in Copenhagen in December 2009 has been a good test ground for this.

The Emergence of a Post-Carbon Society and the Challenges to Environmental Sociology

Discourses are social practices, and even non-discursive practices depend on discourse framings. One can read the observed shift in the CCD discourse (more marked in Germany, but also perceivable in the U.S.) as a constitutive element of a wider socio-technical transition: the emergence of a post-carbon society. Due to space limitations I would like to characterize that emerging society only briefly by stating that it not only is made up by a non-carbon technology and energy base, but also of organizational, political and lifestyle features that fit to that basis – or rather bring it about.

It is not clear which concrete path modern societies will take with regard to their nature 'interface'. Some discourse participants expect the recent CCD changes to become the initial phase of a 'greening of capitalism'. Others envision a new phase of a global 'supercapitalism' (Reich 2007), and the emerging technological basis (solar, wind, green buildings and cars, etc.) as offering a next chance for a new economic 'bubble', following the 'New Economy' and the real estate bubbles since the late 1990s.

A sustainable post-carbon society, however, would have to fulfill at least one criterion: it would be both able and willing to embark on socio-technical experiments. As perfect foresight in social and technological systems is by definition impossible, urgent action in order to avoid dangerous interference with the climate system nevertheless needed, the 'new' CCD does not have many other choices than to embark on a culture of socio-technical experiments. The experimental character of social (self-) transformation has been underlined by Gross and Krohn (2005), arguing from the background of restoration ecology. Brown and Vergragt (2008) argue in the same direction, but based on a domain much closer to the mitigation of GHG emissions, namely zero-energy residential buildings.

This has consequences for the science-society interface, or the co-production of science and society in general (Jasanoff 2003). In this last section I am addressing the particular consequences I see for an environmental sociology that is able to meet the challenges of a post-carbon society.

If we accept an ideal type approach here as well, one can distinguish between the characteristics of the 'old', and the facets of an emerging 'new' environmental sociology. I will contrast them briefly.[16]

First of all, the 'old' environmental sociology was lead by a more implicit question: Why pro-environmental behavior does not work (despite of rather high levels of

[16] Again, I am aware of the stylized character of this distinction, which does not fully do justice to the complexity of thoughts than many colleagues share. Most characterizations only apply to the work of environmental sociologists in the developed world. However, we as sociologists must not complain if one of our methodological battle horses – Max Weber's concept of ideal types – is used in order to describe our own work. It simply is a social fact on top of all the others known. Given the stylized character of my distinction, I will by and large refrain from giving references.

environmental awareness) – and how to overcome this so-called ‘attitude-behavior gap’ with various measures. A main object of observation has been environmental attitudes and, to a lesser degree, behavior. The main focus of this approach was individual or private household behavior, mainly as consumer and/or leisure behavior. Some scholars of this branch of environmental sociology, adhering more to a quantitative approach, seconded environmental psychologists and their almost de-contextualized models of individual behavior.[17] Others, adhering more to a qualitative approach, found support in the sociological tradition of phenomenology or the sociology of everyday life. In both schools of thought, however, the reconstruction of (social, individual) barriers to pro-environmental behavior is key. If discourses are analyzed here, it is more the sociology of the (natural) sciences that attracts interest.

In contrast, a ‘new’ environmental sociology would have to face the described changes in modern CCD. The leading questions do not circle around barriers, but around climate solutions. The starting points are not (individual) barriers, but systemic and organizational capabilities, i.e. the ability of resource-endowed (and embedded) social actors to gradually influence and/or substantially change traditional conditions (like technological pathways). This does not exclude the analysis of constraints (or barriers), the major focus of the ‘old’ environmental sociology. It only embeds the analysis of constraints into a much wider framework of actor capabilities and constraints, according to the dialectical structure of social action (Giddens 1984). The creativity of everyday life is thus more appropriate to start from as imputed barriers. It is not so much the risk of climate change (based upon the use of technologies) that the ‘new’ environmental sociology should pay attention to, but rather the newly emerging risks associated with climate solutions.[18]

The type of knowledge represented in IPCC’s Working Group III has substantially gained in importance. The more corporations, NGOs, governments, or citizens/consumers want to ‘save the planet’, the more a critical environmental sociology has to assess the risks and side-effects of these ‘solutions’. Not with the intention to debunk these solutions or their agents in the first place, but to help preventing new environmental and social risks. This presupposes a much higher willingness and ability of environmental sociologists to cooperate with other scientists. Knowledge in the post-carbon society will be much more trans-disciplinary

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[17] If economic stylizations lead the way, quantitatively oriented environmental sociology can also follow the rational actor paradigm.

[18] The fate of bio-fuels in the public discourse in Germany in 2008 is a good example here. For quite a long time, bio-fuels have been regarded by many experts, corporations, and policymakers as the ‘silver bullet’ with regard to climate neutral mobility. A particularly attractive aspect of bio-fuels has been their rather close technological fit to existing internal combustion engines. However, as many scientists had warned, non-sustainable use of bio-fuels (e.g., in terms of competition for land originally dedicated to food or biodiversity conservation purposes) is well possible, did occur, and was vividly debated in the mass media. As a consequence, the German government had to postpone (if not abandon) its bio-fuel strategy. Another example would be the side-effects of wind power plants, or their vulnerability in case of climate change induced increase in European winter storms.

and situated. This would at the same time require a much higher degree of involvement of sociologists in the work of Working Group III. Up to now, this WG is dominated by economists and the limited scope and boundary assumptions of their neoclassic mode of thought. Non-equilibrium situations will come up much more frequently, as well as systems changes or the deliberate choice between different 'worlds'. Since the days of Emile Durkheim and Max Weber sociologists have conceptualized markets and capitalism differently, with more sense for historic and institutional boundary conditions. We will need this broader scope urgently when we think about the chances – and the risks! – of a post-carbon society.[19]

Especially in the German sociological debate, the stylized figure of the 'sociological observer' is dominating the role model and self-understanding of many sociologists. Time and again Niklas Luhmann has warned us to stick to that role, and to refrain from dangerous and non-scientific properties or activities like empathy, intervention, comment, or even activism. It is not without irony to observe how economists, a much more influential social science group, do in fact shape the decision making space they offer to politicians by their conceptual (and usually implicit political) pre-selections. Economists have influenced poverty reduction programs, fiscal reforms, and climate policies for decades. Knowledge *does* have political implications and consequences. To me it seems better, as a sociologist, to consciously work on these effects, and even to try to increase the public and political influence of our approaches and results, than to absent ourselves from an active contribution to a more sustainable post-carbon society. Given the power plays associated with its concrete formation today, the world could be worse off if sociologists only remain distant observers and interpreters, instead of movers and shakers – an attitude that fits well with the self-stylization of sociology as pure observation, but shies away from our responsibility as a public science, and as part of the society we observe (Lever-Tracy 2008). If the – conflict-prone – post-carbon landscapes are shaped today (Redclift 2009), sociology has to accompany its shaping actively and critically.

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[19] The so-called New Economic Sociology offers some very promising theoretical concepts and empirical studies that environmental sociologists should definitely capitalize on.

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Chapter 4
Earth System Governance and the Social Sciences

Frank Biermann

Abstract In 2001, the four global change research programs ‘urgently’ called for ‘an ethical framework for global stewardship and strategies for Earth System management’. Yet this notion of ‘earth system management’ remains vaguely defined: It is too elusive for natural scientists, and too ambitious or too normative for social scientists. In this chapter, I develop an alternative concept that is better grounded in social science theory: ‘earth system governance’. I introduce, first, the concept of earth system governance as a new social phenomenon, a political program and a crosscutting theme of research in the field of global environmental change. I then sketch the five key problem structures that complicate earth system governance, and derive from these four overarching principles for earth system governance as political practice, namely credibility, stability, adaptiveness, and inclusiveness. In the last part of the chapter, I identify five research and governance challenges that lie at the core of earth system governance as a crosscutting theme in global change research. These are the problems of the overall architecture of earth system governance, of agency beyond the state, of the adaptiveness of governance mechanisms and of their accountability and legitimacy, and of the modes of allocation in earth system governance – in short, the five A’s of earth system governance research.

Keywords Earth system governance • Adaptation • Political science • Global environmental change • Global change research

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Introduction

Humans now influence all biological and physical systems of the planet. Almost no species, no land area, no part of the oceans has remained unaffected by the expansion of the human species. In 2001, the four global change programs DIVERSITAS, International Geosphere-Biosphere Programme, World Climate Research Programme, and International Human Dimensions Programme on Global Environmental Change jointly published a declaration in which they maintained that the earth system now operates "well outside the normal state exhibited over the past 500,000 years." The programmes argued that "human activity is generating change that extends well beyond natural variability – in some cases, alarmingly so – and at rates that continue to accelerate." To cope with this challenge, the programmes then called "urgently" for "an ethical framework for global stewardship and strategies for Earth System management."[1] This concept of "earth system management" is found more and more often in the literature, yet it remains vaguely defined and operationalized. It appears elusive for natural scientists, and too ambitious or too normative for social scientists. For social scientists, "management" is a term often related to notions of hierarchical steering, planning and controlling of social relations. From a social science perspective, "earth system management" as an analytical or normative concept would be both infeasible and – in its connotation of hierarchical planning – undesirable.

In this chapter, I therefore develop an alternative concept that is better grounded in social science theory: "earth system governance" (first developed in Biermann 2005b, 2007).[2] I introduce the concept of earth system governance as a new social phenomenon, a political program and a crosscutting theme of research in the field of global environmental change. I then sketch the five key problem structures that complicate earth system governance, and derive from these four overarching principles for earth system governance as political practice. In the last parts of the chapter, I identify five research and governance challenges that lie at the core of earth system governance as a crosscutting theme in global change research, and discuss problems of research practice. This conceptualization of earth system governance has meanwhile been further developed in the Science and Implementation Plan (Biermann et al. 2009a) of a new long-term worldwide social science research program, the Earth System Governance Project. This new global research project is part of the main social science program in this field, the International Human Dimensions Programme on Global Environmental Change.[3]

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[1] See the mission statement of the Earth System Science Partnership http://www.essp.org/about_essp.html. The text draws on the 2001 Amsterdam Declaration on Global Change. Retrieved July 6, 2009, from http://www.sciconf.igbp.kva.se/fr.html. For a comprehensive scientific treatment, see Steffen et al. 2004.

[2] The rest of this chapter is based on Biermann (2007), with permission of the publisher.

[3] See www.earthsystemgovernance.org, retrieved July 6, 2009, on details.

The Concept

I understand "earth system governance" as the interface of two broad strands of academic inquiry, earth system analysis and governance theory. This section briefly introduces these two research areas. I first review earth system analysis from the perspective of social science, and then continue with the proposal of a two-pillar model of research within the earth system science community and an outline of earth system governance as a subfield within social science.

The notion of integrated "earth system analysis" has emerged from the complexities of global environmental change that require the involvement of most academic disciplines at multiple spatial and temporal scales. Especially in the natural sciences that build on quantification and computer-based modeling, efforts have long been underway to combine and integrate models of different strands of research to gain understanding not of isolated elements of global change, but of the totality of processes in nature and human civilization. Integrated earth system analysis as a scientific enterprise is the consequence of these efforts. Schellnhuber (1998, 1999), a key proponent of the concept, ascribes earth system analysis the status of a science in statu nascendi, because, as he writes (with Volker Wenzel), it has "(1) a genuine subject, namely the total Earth in the sense of a fragile and "gullible" dynamic system, (2) a genuine methodology, namely transdisciplinary systems analysis based on, planetary monitoring, global modelling and simulation, (3) a genuine purpose, namely the satisfactory (or at least tolerable) coevolution of the ecosphere and the anthroposphere (vulgo: Sustainable Development) in the times of Global Change and beyond" (Schellnhuber and Wenzel 1998: VII).

Earth system analysis relates to "sustainability science," a closely connected concept that integrates different disciplines and communities in the larger quest for a transition to sustainability.[4] As Robert Kates, William Clark and colleagues argue, the challenge of sustainable development is so complex that it requires a "sustainability science" as a new integrative field of study (Kates et al. 2001). A sustainability science shall improve collaboration of natural and social scientists as well as deliver research designs that better integrate all scales from local to global. It would also imply modifications of the traditional model of knowledge generation and a new way in which science is conducted (Social Learning Group 2001; Siebenhüner 2004).

Research on institutions and governance mechanisms is often viewed as part of earth system analysis and is formally included in most theoretical conceptualizations in this field. The physicist Schellnhuber, for example, has formalized the notion of a "global subject" S, which he conceptualizes as part of the human civilization H together with the anthroposphere A (the totality of human life, actions and products that affect other components of the earth system). Translated into

[4] Key texts are retrieved July 6, 2009, from http://sustsci.harvard.edu/. See also Clark et al. 2005; Schellnhuber et al. 2004; as well as the reports of the Friibergh Workshop on Sustainability Science, held 11–14 October 2000 in Friibergh Manor, Örsundsbro, Sweden.

social science language, this "global subject" *S* could be seen as the political system at the global level including its national and subnational subparts, all of which share the collective ability to bring the "human impact" in line with the needs of the ecosphere (Schellnhuber 1999: C20–C22; Schellnhuber and Biermann 2000). Likewise, the Earth System Science Partnership asserts that "the core" of its activities will be the "in-depth analysis and advanced modelling of the Earth System as a whole, incorporating data and information from the diverse fields represented by the four global change programmes."[5]

In practice, however, it remains unclear to what extent institutional and governance research can contribute to, and integrate with, these more model-driven research programmes, apart from problem-oriented, issue-specific collaboration. Quantifiable hypotheses and computer-based modeling are problematic for most students of institutions and governance (Young et al. 2005). Social science research groups that attempt to use computer modeling and quantification as a tool for integrating governance research into larger models have still to provide convincing results. Qualitative modeling projects to analyze international governance processes and institutions are in their infancy (Eisenack 2003; Eisenack et al. 2006). Major problems in modeling governance processes remain, to name a few, the complexity of relevant variables at multiple levels, human reflexivity, and difficulties in conceptualizing key social concepts such as "power," "interest" or "legitimacy."

Given this mismatch between formalized methods and fuzzy social realities, proponents of an integrated earth system analysis often relegate governance research to an auxiliary, advisory, and essentially non-scientific status. Quite typical is the conceptualization of social science in the 23 questions that the Global Analysis, Integration and Modeling task force of the International Geosphere-Biosphere Programme has put forward as overarching questions for the earth system analysis community (Schellnhuber and Sahagian 2002). Some of these questions relate to the social sciences. However, these social science questions are not viewed as part of the "analytical" questions (which are exclusively related to natural science), but as part of the "strategic" questions (for example question no. 23, "What is the structure of an effective and efficient system of global environment and development institutions?"), or "normative" questions (for example, question no. 18, "What kind of nature do modern societies want?"). The value of institutional research as an *analytical* program of inquiry is relegated to its policy-oriented, advisory dimensions. It appears that this is a logical outcome of an earth system analysis programme that is motivated by computer modeling and quantification.

Consequently, I argue that students of governance should resist subjecting their governance and institutional analysis of human-nature interactions to computer modeling, quantification and epistemological uniformism and to methods that are unfeasible to implement and impossible to trust in the social sciences. Instead, social scientists will need to continue to develop *independent research programmes*

[5] See the Partnership's mission statement. Retrieved July 6, 2009 from www.essp.org.

that are interdisciplinary across the different social sciences – for example, linking international relations and law – but that follow the internal logic and particular theoretical, epistemological and methodological approaches of the social sciences and the humanities, which are in most cases qualitative, case-based, context-dependent, and reflexive.

One overarching theme for such a research programme, I argue, is earth system governance. The study of earth system governance is thereby part of the larger project of global change research, yet must also remain autonomous in its distinct methodological and theoretical development.

Global change research therefore rests on two theoretical and methodological pillars: One is earth system analysis driven by an integrated computer-based approach that brings together models and modules of natural sciences as well as of some social sciences that are able to contribute models and quantified data, such as economics and some strands of geography. The other pillar is the development of an earth system governance theory that unites those social sciences that analyze organized human responses to earth system transformation, in particular the institutions and agents that cause global environmental change and the institutions, at all levels, that are created to steer human development in a way that secures a "safe" co-evolution with natural processes. Both pillars are crowned by a common, collaborative roof that organizes issue-specific cooperation between the pillars, for example in the various joint projects of the Earth System Science Partnership, such as the Global Environmental Change and Food Systems Project, the Global Water System Project, the Global Carbon Project, or the Global Environmental Change and Human Health Project.[6]

This research programme on earth system governance is also inherently part of the larger discourse in the social sciences on new institutionalism and governance. Even though "governance" is not uniformly defined in the social sciences (van Kersbergen and van Waarden 2004), it usually denotes new forms of regulation that differ from traditional hierarchical state activity and implies some form of self-regulation by societal actors, private–public cooperation in the solving of societal problems, and new forms of multilevel policy. (Other usages less relevant here are normative in the sense of "good governance" and management-oriented in the sense of "corporate governance".)

Earth system governance thus also relates to the discourse on "global governance" (Commission on Global Governance 1995; Dingwerth and Pattberg 2006; Kanie and Haas 2004; Rosenau 1995; Young 1994, 1997). "Global governance" is often used as a *description* of modern world politics, sometimes limited to traditional forms of international relations (Finkelstein 1995: 369), sometimes broader to encompass a variety of social and political interactions at all levels (Rosenau 1995: 13). The term is also used as a political *prescription* to cope with problems of modernity, for example in calls for "global governance" as a counterweight to globalization (Commission on Global Governance 1995; Smouts 1998). As a political project,

[6] Information and links to all project websites retrieved July 6, 2009, at www.essp.org.

global governance has also been criticized, for instance from the perspective of historical materialism (Overbeek 2005) or of developing countries (South Centre 1996: 32). Yet notwithstanding these differences in conceptualization, much of the advance in theoretical and empirical knowledge on global governance will be fruitful also for the development of a theory of earth system governance.

In sum, earth system governance is not confined to states and governments as sole actors. It is marked by participation of myriad public and private non-state actors at all levels of decision-making, ranging from networks of experts, environmentalists and multinational corporations to agencies set up by governments. Earth system governance can therefore be defined as *the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development*.[7]

This notion of earth system governance is phenomenological inasmuch as it describes an emerging social phenomenon expressed in hundreds of international regimes, international bureaucracies, national agencies, local and transnational activists groups and expert networks. At the same time, earth system governance can be understood as a political project that engages more and more actors who seek to strengthen the current architecture of institutions and networks at local and global levels. And in both meanings, earth system governance is a demanding and vital subject of research for the social sciences.

As such, earth system governance bridges traditional levels of analysis in governance and policy studies. On the one hand, it goes beyond environmental policy analysis as it emerged in the 1970s with its focus on managing environmental problems of industrialized countries. The anthropogenic transformation of the earth system encompasses more puzzles and problems than have been traditionally examined within environmental policy studies, now ranging from changes in geophysical systems to the global loss of biological diversity. Key questions – such as how Bangladesh could adapt to raising sea levels, how deterioration of African soils could be halted or how land-use changes in Brazil could be analyzed – have barely been covered by environmental policy research. Yet they are inevitably part of the study of earth system governance. On the other hand, earth system governance covers more than problems of the "global commons," but also local problems from air pollution to the preservation of waters, waste treatment or desertification and soil degradation. Earth system governance thus requires the integration of governance research at all levels. It must bridge scales from global to local.

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[7] This definition is the same used in the Science and Implementation Plan of the IHDP Earth System Governance Project (Biermann et al. 2009a). See www.earthsystemgovernance.org, retrieved July 6, 2009, for details.

Problems and Principles

This section further expands on the concept of earth system governance. It begins with laying out the problem structure of earth system governance that makes it a special and unprecedented challenge for both researchers and decision-makers. From this problem structure, I derive four general governance principles that could underpin earth system governance in the twenty-first century. The next section then lays out the core research questions that, based on the current state of knowledge, flow from the identification of problems and principles.

Problem Structure

Earth system governance must cope with at least five problem characteristics that make it a particular difficult governance challenge.

First, the anthropogenic earth system transformation is marked by *persistent uncertainty* regarding the causes of global environmental change, its impacts, the interlinkage of various causes and response options, and the effects of possible response options. Most transformations, such as global climate change, are nonlinear and might accelerate, or slow down, at any time. Surprises in system behavior can be expected, but are by definition unforeseeable. The history of the belated and partially accidental scientific discovery of stratospheric ozone depletion and its human-made causes has been particularly well documented in the literature, with its intriguing story of computer systems that excluded high ozone depletion as measurement errors, of scientists who first did not report their findings, and of politicians who first refused to act (Litfin 1994). Uncertainty has found its institutional response in repeated rounds of global environmental assessments that have brought together the world's leading scientists in complex institutional settings, with the Intergovernmental Panel on Climate Change as a prime example. Yet these scientific assessment and research institutions cannot resolve the persistent uncertainty that continues to complicate earth system governance.

Uncertainty is not only analytical, but also normative. Most problems of earth system transformation are unprecedented. The adequate policies, polities and, especially, modes of allocation are uncertain, initially always contested, and need to be developed and agreed upon by societies over time. Uncertainty hence poses particular governance challenges. It requires governance to be stable over decades and centuries to withstand sudden changes of earth system parameters (or changes in our knowledge about these parameters), but also to be flexible enough to adapt to changes within the larger stable framework. Governance must be oriented towards the long term, but must also provide solutions for the near future. Normative uncertainty requires the development of new norms and conceptual frameworks for global collective action in uncharted territory. The global allocation of "emissions rights" in climate governance, which oscillates between the extremes of equal per capita allocation and allocation according to existing use, is a prime example (Biermann 2005a). Analytical and normative uncertainty is part of any collective decision-making. In earth system governance, it is extreme.

Second, the anthropogenic transformation of the earth system creates *intergenerational dependencies* that pose further exceptional governance challenges. Cause and effect of earth system transformations are usually separated by decades, often by generations. The same holds for the decoupling over decades of the costs of mitigation and the benefits of avoided harm. Sea-level rise, for example, is expected within a time-range of 100 years: Such planning horizons exceed the tenure and even the lifetime of present decision-makers and stakeholders. Among other things, this poses the challenge of international credibility and trust that future governments will reciprocate and comply, and the problem of democratic legitimacy of policies in the intergenerational context. What rights and responsibilities do present generations, and their representatives in parliament, have towards their unborn successors? Intergenerational equity and responsibility is not confined to earth system governance – it is also, for example, part of many social security systems. Yet in earth system governance, intergenerational interdependence is at the core.

Third, earth system governance must respond to the *functional interdependence* of earth system transformation and of potential response options. Functional interdependence relates to the interdependence of natural subsystems – linking, for instance, climate change to biodiversity or land degradation – as well as to the interdependence of social systems and policy areas. Response strategies in one problem area or one policy domain are likely to have repercussions for other areas. Functional interdependence also relates, in many problem segments, to the mutual substitutability of response options, which poses particular problems of international allocation. In climate governance, for example, for every global policy target there are an unlimited number of possible combinations of local responses across nations and time frames with equal degrees of effectiveness. Functional interdependence requires policy coordination and integration to the extent possible. It lies at the heart of the discourse on environmental policy integration at the national level as well as of recent attempts to cluster the plethora of international regimes into core groups, such as a "chemicals cluster" or "biodiversity cluster" (von Moltke 2005).

Fourth, the anthropogenic transformation of the earth system creates new forms and degrees of (global) *spatial interdependence*. This relates to both natural (direct) and social (indirect) interdependencies. Natural interdependencies are functions of the earth system that transform local environmental pollution into changes of the global system that affect other localities. Prominent examples are climate change, stratospheric ozone depletion, the global distribution of persistent organic pollutants, and the global spread of species with potential harm for local ecosystems. Social interdependencies are functions of the (global) social system that transform local environmental degradation into transregional or global social, economic and political crises. This includes negative influences on the world economy, for example because of large-scale flooding, drought or disease. It also includes negative influences on the material security of human populations, for example, when regional climatic change causes decreases in food production and thus increases in global food demand and food prices. Eventually, these social interdependencies will affect global and regional security. Economic crises or mass migration due to transformation of the earth system will not be confined to some states. They will affect all. Spatial ecological interdependence binds all nations. This creates a new dependence of states, even the most powerful ones, on the community of all others. This spatial interdependence is a defining characteristic as well as a key challenge of earth system governance that requires an effective institutional framework for global cooperation, more so than most other areas of foreign policy.

Fifth, earth system governance has to cope with, and gains its particular relevance from, the *extraordinary degree of harm* that is possible, and that current governance systems might not be fully prepared for. Sea-level rise, food shortage, drought, storms, land degradation, reproductive disorder and many other consequences of earth system transformation – if unchecked – are conceivable. Some might be catastrophic, such as changes in monsoon patterns or in the thermohaline circulation, large-scale breakdown of ecosystems, or rising sea levels in low-lying countries. Developing countries in particular are ill prepared to adapt to these changes that might require in some cases large-scale migration and transnational food assistance. Earth system governance is challenged in many ways. Extreme impacts could exceed the regulatory capacity of individual states, both in affected regions and in less affected potential donor regions. Global assistance, including globally coordinated planning and preparing, is needed. Global solidarity led states and private citizens to transfer substantial funds to victims of disasters in the past, from the flood assistance to the Dutch in 1953 to the Tsunami aid programmes in early 2005. Yet the extent of potential impacts of earth system transformation will put global solidarity to the test, in particular when mass migration – for example from low-lying islands – is the only practical and financially viable option.

Governance Principles

These problem characteristics of the global transformation of earth system parameters through human action – high analytic and normative uncertainty, high temporal, functional and spatial interdependence, and potentially extreme impacts – are unprecedented in the governance of human affairs. From these characteristics of earth system transformation, I derive four core principles of earth system governance.

Credibility First, effective earth system governance requires governments to commit resources both domestically and through transnational transfer mechanisms for mitigation and increasingly adaptation policies. Given the uncertainty and temporal and spatial interdependence of anthropogenic earth system transformation, governments will need to commit these resources based on the assumption that other governments will reciprocate when it is their turn – including the still unknown future governments of other nations. Earth system governance must thus produce the necessary credibility for governments and others to believe in this reciprocity of interaction partners over time and space.

Stability High uncertainty and high temporal, functional and spatial interdependencies require that earth system governance is stable enough over decades to withstand political changes in participating countries or changes in the world political system. Governments that commit resources within a global normative framework in the present must rely on the perseverance of this framework over time. Yet effective transnational institutions and governance systems with a time-horizon of centuries are rare – the Catholic Church with its 2000-year stable leadership succession and decision-making mechanisms is probably the only transnational empirical example. It will be a key task for analysts to chart ways for such stable systems of earth system governance in the twenty-first century.

Adaptiveness Within this stable framework, actors must have the ability to change governance elements to respond to new situations, without harming both credibility and stability of the entire system. The tension between stability and credibility, on the one hand, and the need to respond quickly to new scientific findings and new interest constellations is one of the key challenges for earth system governance. Governing has always implied a degree of social learning and of adaptation to changed circumstances. Earth system transformation brings with it new challenges regarding the degree and speed of potential change. The conditions for effective and equitable "adaptive governance" are increasingly discussed at the local and regional levels, for example concerning water system governance. The conditions for effective global adaptive governance of large-scale earth system transformations during the twenty-first century within a stable and credible global institutional order are less understood.

Inclusiveness The interdependence of earth system governance, as well as the complexity and uncertainty of the entire system that may change the overall interest constellation within a few years, require the governance system to be as inclusive as possible regarding the stakeholders involved. This requirement of "participatory governance" includes weaker states that might lack influence in world politics but are important both for mitigation and adaptation efforts. In particular developing countries are significantly more relevant, and hence more powerful, in key issue areas of earth system governance, from climate change to biodiversity governance. Participatory governance is also the challenge of including non-state stakeholders in decision-making at local and global levels, since the complexity and uncertainty of earth system governance cannot be resolved through action by public agents alone. However, this inclusion of private actors and "civil society" requires methods and mechanisms that are perceived by all stakeholders as legitimate, effective and fair.

Research Challenges

Earth system governance is an emerging empirical phenomenon as well as a political project of the twenty-first century. In both dimensions, it is a demanding challenge for the study of the human dimensions of global environmental change and for social science in general, which must generate theoretical insights and practical tools to develop effective structures of earth system governance. In the following section, I develop five key clusters of questions that could guide a focused research effort in earth system governance theory as a crosscutting theme of global change research. These are the research problems of the overall *architecture* of earth system governance, of *agency* beyond the state, of the *adaptiveness* of governance mechanisms and of their *accountability* and legitimacy, and of the mode of *allocation* in earth system governance – in short, the five *A's* of earth system governance research.

Architecture

First, I argue that the governance principles of stability, credibility and inclusiveness require refocusing research efforts on the overall "architecture" of earth system governance. Most research in this field in the last 30 years has focused on single institutions. We now have a better understanding of the creation, maintenance and effectiveness of international environmental regimes, as well as better methodological tools to study these phenomena (for overviews, cf. Helm and Sprinz 2000; Mitchell 2003; Young 2001). It has been shown, for example, that different international norms and verification procedures, compliance management systems, modes of regime allocation as well as external factors, such as the structure of the problem, all influence regime effectiveness. Most of these studies have focused on the effectiveness of single institutions, often within larger comparative projects (e.g., Gupta and Falkner 2006; Haas et al. 1993; Keohane and Levy 1996; Miles et al. 2002; Victor et al. 1998; Young 1997; Young et al. 1999). More recently, the increasing number and scope of international environmental institutions has led to new research on their interaction, for example in studies on regime interlinkages, regime "clusters" or regime "complexes" (Biermann et al. 2009b; Chambers 2001; Oberthür and Gehring 2006; Rosendal 2001a, b; Stokke 2000; Velasquez 2000). Institutional interplay has also been one the three research themes of the Institutional Dimensions of Global Environmental Change project of IHDP that ended in 2006 (Institutional Dimensions of Global Environmental Change Project 1999; Young 2002; on the results see Young et al. 2008).

These approaches to understanding the effectiveness and the interaction of different institutions had to be methodologically reductionist to be successful. Distinct institutions, sometimes distinct elements of larger institutions, have been analyzed regarding their effectiveness and their relationship to other institutions or institutional elements. The macro-level – that is, the system of institutions that address aspects of earth system governance – has remained largely outside the focus of the major research programmes. Given the advances in regime theory and institutional analysis, further progress now requires a complementary research programme that analyses this macro-level. I call this the *"architecture"* of earth system governance, that is, the interlocking web of principles, institutions and practices that shape decisions by stakeholders at all levels (see in more detail also Biermann et al. 2009b).

The structure and effectiveness of this overall architecture still remains a research frontier. Key questions are, for example, the extent to which such an architecture must restrict state sovereignty; the kind and character of the universally accepted constitutional norms needed to support such an architecture; the kind of mechanisms that guarantee effective vertical interaction of governance systems across levels and scales; and the need for universal inclusion and participation among states. The quest for an overarching architecture of earth system governance relates also to recent debates on strengthening the UN system in this field, in particular with a view to policy proposals for a larger integrated organization such as a "world environment organization" or a "UN environment organization" (Biermann and Bauer 2005).

Agency Beyond the State

Second, credible, stable, adaptive and inclusive earth system governance requires the consent and involvement of actors beyond governments and state agencies. Many vital institutions of earth system governance are therefore today inclusive of, or even driven by, non-state actors, ranging from public non-state actors such as intergovernmental bureaucracies (Biermann and Siebenhüner 2009) to purely private actors such an environmentalist alliances, scientific networks, and business associations (Arts 1998, 2002; Betsill and Corell 2001; Conca 1995; van der Grijp and Brander 2004; Gupta 2003; Levy and Newell 2004; Princen et al. 1995; Raustiala 1997; Wapner 1996). These activities of non-state actors are no longer confined to lobbying or advising governments in the creation and implementation of international rules. Increasingly, non-state actors now participate in global institutions and negotiate their own standards, as in the Forest Stewardship Council, the Coalition for Environmentally Responsible Economies, or the Marine Stewardship Council (Falkner 2003; Pattberg 2005, 2006b). Public–private cooperation has received even more impetus with the 2002 Johannesburg World Summit on Sustainable Development and its focus on partnerships of governments, non-governmental organizations and the private sector – the so-called Partnerships for Sustainable Development (Glasbergen et al. 2007).

The effectiveness of such public–private or fully private initiatives, however, is insufficiently understood. Most advances in the study of earth system governance have traditionally been linked to inter-*governmental* cooperation and to states as core actors. We have an elaborate literature on the foreign policy of states, including their environmental foreign policy, and on institutions created and regulated by states. We still lack comparable knowledge on the behavior of non-state actors and on the institutions that they create. Moreover, most recent literature on private cooperation still builds on single-disciplinary case-study research with case selection often influenced by practical considerations or flawed through case-selection on the dependent variable, in particular where only "success stories" are chosen. The major effort of the 1990s on analyzing inter-governmental environmental regimes thus needs to be complemented by a similar research programme on "global participatory governance" that explores the public–private and private institutions in earth system governance.

Adaptive Governance and the "Adaptive State"

Third, the five problem characteristics of earth system governance developed above place new burdens on the core functions of the state, which needs to evolve into an "adaptive state." The adaptive state will be challenged in three ways: by decreased autonomy through increased dependence on other states, increased need for legitimacy, and increased stress through the need to adapt to sudden alterations of the natural environment.[8]

First, the spatial interdependence – regarding both natural and social interdependence – of global environmental problems has made states directly dependent on the activities of other states. The guarantee of security and the protection of citizens are now possible only in a governance system that transcends state boundaries. Unlike economic interdependence that was debated in the 1960s and 1970s (e.g., Keohane and Nye 1977), ecological interdependence is inescapable even for the most powerful nations. Ecological interdependence binds all nations, which creates a new dependence of all nations on the community of all others.

Second, spatial and temporal interdependence as well as analytical and normative uncertainty create new problems for the legitimacy of state action. Drastic mitigation programmes today will mainly benefit – through reduced harm – future generations, which will suffer less from floods, droughts or breakdowns of ecosystems. In addition, most beneficiaries will live beyond a state's borders. Normative uncertainty inevitably requires current generations to work towards a model of earth system governance and, implicitly, towards a future state of the earth system whose desirability for future generations remains unknown. Known are merely the costs for current generations, which need to be legitimized if drastic actions are taken. All this places new burdens on the legitimacy of state action.

Third, adaptation to earth system transformations poses additional burdens on *state capacities*. The more environmental change puts stress on societies – for instance through drought, regional climate changes or sea-level rise, but also through new mitigation requirements – the more will state capacities be in danger of becoming overstretched, with local and regional crises as a possible consequence. Given the uneven geographic distribution of adverse consequences of global environmental change, some states will face more demands for adaptation than others. Since developing countries will suffer most from a lack of capacities

[8] See here the special issue of *Global Environmental Politics*, *4(1)*, 2004, Global Environmental Change and the Nation State., and in particular the introduction to the issue by Biermann and Dingwerth (2004).

to address the social, economic and environmental problems within their boundaries, their capacities are likely to be stretched most by global environmental change. The added stress that earth system transformation places on states limits their options to fulfill other functions such as guaranteeing political participation and creating minimal social conditions. Earth system change requires states to prepare for and adapt to its consequences and thus increases the demand for the administrative, organizational, technological and financial capacity of the "adaptive state" – a demand that some states will find easier to meet than others.

While much research has focused on the role of the state in the advancement of public goals and public goods – economic development, individual freedom, democracy – a key question of earth system governance will be the analysis of the "adaptive state": a state able to adapt internally and externally to large-scale transformations of its natural environment.

Accountability

The three research themes of earth system governance that I have described create problems of accountability and legitimacy. Credible, stable and inclusive governance must be perceived as legitimate by all stakeholders, and its actions and representatives must be accountable to their constituencies. In the twentieth century, legitimacy and accountability was a problem of national governments. In the twenty-first century and its new needs of earth system governance, accountability and legitimacy appear in a different context. Eventually, this comes down to the quest for *democratic* earth system governance.

There are two broad types of research needs: First, a theoretical one. In purely intergovernmental norm-setting processes, legitimacy is conferred indirectly through the accountability of governments to their voters. Likewise, international bureaucracies can derive legitimacy through their principals, the governments, which are accountable to their voters. However, such long lines of accountability have been questioned in recent years (e.g., Dingwerth 2005; Dryzek 1999; Held 1997; Scholte 2002). Many authors see a solution in the participation of private actors in global governance. David Held, for example, recognizes " 'new' voices of an emergent 'transnational civil society' ... in the early stages of development ... [that] point in the direction of establishing new modes of holding transnational power systems to account, that is, they help open up the possibility of a cosmopolitan democracy" (Held 1999: 108).

Problematic is, however, the accountability and legitimacy of these private actors themselves. In the domestic context, private organizations derive legitimacy through their members or donors – even though members and donors often have no formal means to decide the policies of the organization. They can also gain legitimacy from the environmental good that they seek to protect. In the Philippines, for example, nongovernmental groups have successfully claimed in court to derive legitimacy and *locus standi* by representing the interests of future generations. In the international context, however, with its high disparities in wealth and power, accountability and legitimacy of private actors is more complicated. Most philanthropic organizations are headquartered in industrialized countries, and most funds donated to their cause stem from the North, both public and private. It is likely that this influences the agenda of these groups and makes them more accountable to Northern audiences (Commission on Global Governance 1995; South Centre 1996).

This leads to the second, practical challenge: Because of these disparities, researchers need to design, and practitioners to develop, institutions that guarantee participation of civil society in earth system governance through mechanisms that vouchsafe a balance of opinions and perspectives. For example, networks of transnational private actors can seek to balance views and interests through self-regulation, including financial support for representatives from developing countries. This is done for instance through North–South quotas in meetings and alliances of non-state activists within the UN Commission on Sustainable Development. Also the Intergovernmental Panel on Climate Change, as a form of institutionalized participation of non-state actors in earth system governance, could serve as a model for the effective participation of both developing countries and non-state actors from the South (Agrawala 1998a, b; Siebenhüner 2002, 2003; Biermann 2001, 2002). Another option to increase legitimacy and accountability of earth system governance by strengthening private participation in a balanced way could be a "quasi-corporatist" institutionalization. The Commission on Global Governance (1995: 258), for example, proposed an international Forum of Civil Society within the United Nations, which would comprise of 300–600 "organs of global civil society" to be self-selected from civil society.

Allocation

Finally, earth system governance must be perceived as fair and equitable by all stakeholders in order to be effective. Politics is about the distribution of resources and values, and earth system governance is no different. Modes of allocation are key factors for its stability, credibility and inclusiveness. With the increasing relevance of earth system governance in the twenty-first century, allocation mechanisms and criteria will thus become central questions to be addressed by social scientists as well as decision-makers. This is particularly pertinent for the relationship between North and South, which has defined the central conflict line in many areas of earth system governance, ranging from global climate (Gupta 1997; Biermann 2005a) to forest policies (Pattberg 2006a).

At stake are not only the costs of mitigation. Given the potential disastrous consequences of earth system transformations, questions of fairness in adaptation will arise (Adger et al. 2006). Compensation and support through the global community of the most affected and most vulnerable regions, such as small island states, will not only be a moral responsibility. It will also be politically and economically prudent.

Yet despite this central relevance of allocation, research in this field has been scarce in the past, in particular regarding empirical research programmes that could lend substance to the more policy-oriented, philosophical treatises on equity.

Few research efforts have yet been directed at understanding the causal pathways that lead to specific allocation mechanisms, and the consequences of different allocation mechanisms in earth system governance are equally insufficiently understood. Little systematic analysis has also been devoted to studying allocation as independent variable and to analyzing allocation mechanisms in relation to variant effectiveness of the core institutions of earth system governance. In short, given the growing relevance of earth system governance in the twenty-first century in terms of both mitigation and adaptation costs, allocation is certain to become a major concern for researchers and practitioners alike.

Conclusion

This chapter has sketched the emerging field of earth system governance as an empirical phenomenon of world politics and as a crosscutting programme for the global change research community. I have laid out the key problem characteristics and governance principles, as well as five major research challenges: architecture, agency, adaptiveness, accountability, and allocation.

More than anything else, this makes earth system governance one of the most challenging, but thus also one of the most exciting research fields in the social sciences. As a political programme, it is no less daunting. The bolder visions of the earlier philosophers, such as Seneca's idea of a *res publica* whose boundaries would be "the sun alone" (*De Otio*, §IV, 1) or Kant's proposal of a global federation of states for "the eternal peace," seem hardly more realistic today than they were in their days. Yet earth system governance is emerging. More than 900 international environmental agreements are in force. Many harmful substances, such as the ozone-depleting chlorofluorocarbons, have been phased out through international cooperation. Mitigation and adaptation projects against global warming are mushrooming in many places, from India to the Netherlands, often inspired, guided or coordinated by global collaborative programmes.

Yet how to create a global and effective architecture for earth system governance that is adaptive to changing circumstances, participatory through involving civil society at all levels, accountable and legitimate as part of new democratic governance beyond the nation state, and at the same time fair for all participants: this research and governance challenge still lies ahead.

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Chapter 5
Ecological Regimes: Towards a Conceptual Integration of Biophysical Environment into Social Theory

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Abstract Due to their view of the constitution of the 'social', social sciences tend to exclude the biophysical environment from their subject matter. In order to prevent naturalistic explanations, only social explanantia have been taken up in explanatory approaches to social facts. However, increasing environmental problems and the discourse on sustainable development cast severe doubts regarding the exclusion of the biophysical environment. Accordingly, several approaches strive to integrate biophysical aspects into existing social theory. Most of these theoretical approaches are, however, limited to either focusing upon the level of individual action or on the macro level. The institutional level largely remains underexposed. In respect of this research desideratum the paper presents the concept of "ecological regimes", which provides an innovative contribution to integrate the biophysical environment into existing social theory on level of aggregated action.

Keywords Environmental problems • Paradigm change • Naturalism • Aggregated action • Societal metabolism

Challenges for Society: Challenges for the Social Sciences

Since the late 1970s, modern society has been engaged in a discourse regarding being in an ecological crisis.[1] Jahn and Wehling (1998) for instance identified the underlying core issue as a crisis of societal relations vis-à-vis nature. More than 25 years ago Catton and Dunlap (1980) already drew our attention towards major

[1] Gross (2001) reminded us that Max Weber already discussed topics such as scarce resources or nature's exploitation and that these topics motivated social movements and initiatives around 1900.

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environmental challenges and summarized them in a seminal paper. A few years later, Ulrich Beck conceptualized the development of modern societies in his book *Risk Society* (1986), published in the wake of the Chernobyl disaster. He argued that society is confronted with new kinds of risks, and thus forced more than ever to react to the consequences of human impact upon nature. Today environmental challenges have reached global proportions. The effects of climate change are compelling human societies to adapt to environmental mutations, extreme events and even to severe losses of biodiversity. Furthermore, issues around the global utilization of scarce resources (renewables and non-renewables) are also confronting society with increasing challenges nowadays.[2]

These developments are also presenting the social sciences with new challenges. Social sciences can be understood as a methodologically established reflection on social action. Their functions are to describe, analyze and find causal and functional explanations for societies, societal relations, social structures, and change. Moreover, and taking into account their position within a reflective risk society, social sciences may also claim to fulfill a consulting function within societal decision making processes. They can contribute to the production of knowledge for action through facilitating the evaluation of possible societal consequences or providing risk management support. Given these functions, the question arises whether traditional social theories really enable the social sciences to explain the causes and reasons for contemporary development processes adequately or to contribute to societal decisions within the domain of sustainable development legitimately and reflectively.

Generally speaking, one might expect social sciences to take the changing natural environment into account as substantial influencing factor on modern societies. Sustainable development, now at least verbally accepted as a new global role model for societal development, systematically integrates the biophysical environment into social development by taking the scarcity of global environmental (ecological) resources into account. In terms of counterfactuals: if it were not the case that ecological resources are scarce on a global level and that their scarcity provokes serious risks for the development of human society, then it would not be the case that "scarcity of ecological resources" could enter the social sciences as an explanans. However, the reality is that global resources have become scarce. Accordingly, in order to cope with this at a theoretical level, we must allow integration into the social theories in some sense or another.

Moreover, many subject fields in social sciences like mobility, the use of resources, methods of production, age, gender, etc. provide examples of interrelation between the social and the biophysical. We might of course be tempted to restrict mobility analysis to topics such as milieus, lifestyles, economic drivers,

[2]"Environmental" crisis has become a very popular locution these days. Although there can be no doubt concerning the different risks, we would like to appeal for a more cautious handling of the term "crisis". As it is rather doubtful to treat the past 40 years as a continuously ongoing environmental crisis, we prefer to talk in terms of risks and challenges.

environmental perception, etc. However, without considering the wider effects of mobility – such as the resulting infrastructure, noise, CO_2 and other emissions, not to mention the associated regulatory and legal frameworks, attitudes and the like, our explanations of the societal phenomenon "mobility" will be strongly one-sided. The contemporary discourse on mobility cannot be seriously analyzed without for instance taking into account states of affairs such as CO_2- or PM10-emissions. The same type of argument can be applied to the other example mentioned above. Hence, they draw our attention to the fact that an analysis of major societal phenomena is not possible without including the biophysical environment. Research topics within sub-disciplines of sociology for example such as environmental sociology, sociology of technology or sociology of the human body lead us to expect that biophysical aspects always have to be taken into consideration. Accordingly, we would like to conclude that the debate should focus on the "how", and not on the why and wherefore of the task itself. There is not enough space to discuss issues from sociology of technology or sociology of the human body. The crucial point with regard to environmental sociology is, in what respect, and to what degree, biophysical aspects really enter into its explanations. Do they enter as social perception or as explanantia?

Contrary to our expectation, mainstream social sciences renounce to accept biophysical aspects as explanantia. The analysis of the interrelation between society and its biophysical environment still seems to be a difficult and challenging endeavor. A social scientist using, for example, notions such as vulnerability, resilience, or adaptation to explain societal reactions is very often condemned as being a naturalist. Excluding biophysical elements, however, makes it difficult to understand how social sciences may be able to contribute with explanations of, or reflective approaches towards, the societal process for sustainable development.

What are the reasons for this reluctance to accept biophysical facts as explanatory factors in social sciences? We argue that the general paradigm about the constitution of the social is the main reason. Sociology, the discipline which provides the most important theoretical basics for social sciences, was established as an independent discipline by constructing the "social" as an autonomous self organized reality. The "objective reality of social facts" (Emile Durkheim) was conceptualized as asking exclusively for social explanations. Hence, we argue that the leading paradigm of sociology forms the linchpin of the social sciences. It hinders the development of adequate theories of the society-environment-interrelations, i.e. the taking of recursive influence of biophysical facts on societal development into account, because it excludes non-social facts from entering social theories as explanantia.

We claim that a discrepancy exists between the theoretically based self-understanding and the functions of social sciences. The core element in self-understanding is the task of keeping the autonomy of the social. The core function of social sciences is to contribute to an adequate understanding of the social and to add reflective information on society. According to the previously developed argument regarding the domain of sustainable development, we claim that the traditional paradigm renders social sciences ill-prepared to fulfill their cognitive function within the domain of sustainability (Burger 2007; Zierhofer et al. 2008), because it does not allow for non-social explanantia. The core topic characterizing sustainable development as a societal concept is the challenging relationship between social and biophysical facts.

It is of utmost importance to grasp the identified discrepancy and the resulting consequences as precisely as possible. At a first glance, one might gain the impression that we are going to remove the very idea of the autonomy of the social. However, this is not our intention. Instead we argue for a revised understanding of the autonomy of the social. The first question we would like to ask is, whether "autonomy" necessarily implies "explaining the social exclusively by the social". We reject the validity of such an implication without denying the existence of evidence for social autonomy. Moreover, we also demand that theories on the interrelation between society and biophysical environment must be in accordance with known evidence for autonomy and avoid methodological naturalism. In the following chapter we not only argue that there are good reasons to separate "autonomy" and "explaining the social exclusively by the social", but we further present the core idea for an alternative paradigm. In chapter three we will then discuss the approach of societal metabolism, which offers the potential to integrate biophysical aspects into social theory. Our discussion has a twofold aim, namely to defend the theory against criticism and to identify important desiderata. Against that background we will present in chapter four our concept of ecological regimes.

An Alternative Paradigm

To cover the above-mentioned gap in social sciences, we have to get to the bottom of sociology's methodology in order to make it adjustable enough to conceptually integrate the biophysical environment. We commence this section with an explanation of our understanding of fundamental terms such as "paradigm", "autonomy of the social", "biophysical environment" and "naturalism" and then proceed to scrutinize the possibilities for an alternative paradigm.

When it comes to "paradigm", we basically rely on Kuhn's (1997) core idea that any broader scientific domain at a given time is characterized by a small set of leading basic theoretical assumptions. Whether a specific empirical or theoretical approach counts as a contributing part for a science is dependent upon this underlying set of basic assumptions – constituting its paradigm. Whatever the relations between different sets of basic assumptions within a domain may look like (e.g., translatable or not), one cannot rationally claim that two competing sets are equally true (i.e. creationism and theory of evolution or Newtonian mechanics and theory of relativity).

The dominant paradigm for sociology was already formulated in its early phase. Social phenomena must be explained by social facts – this has been the methodological basis of social sciences since Durkheim (1984).[3] Later, Max Weber postulated that social structures have to be understood as related actions, which have to be explained by the interpretive reconstruction of subjective meaning (Weber 1985: 1). More recently, Niklas Luhmann pointed out that social systems are autopoietic and autonomous, as they basically rely on communication and subsequent communication as type of interaction between its elements (humans) (Luhmann 1997: 92 ff). Although Luhmann's and Weber's approaches represent two different lines of social reasoning, they both fully rely on the stated methodological paradigm. The constituting elements such as symbolic communication or meaning are understood as autonomous processes. The social organizes itself and has to be explained out of the social for both of them.

From this perspective it seems, at a first glance, not only comprehensible, but also necessary that social sciences follow a postulated social autonomy to explain social facts. Moreover, no serious scientist can dare to claim that using symbols in communication or norm following social actions can be explained by psychological or biological dispositions. There are strong reasons for understanding the social as a self-organized, hence autonomous system. More questionable, however, is the argument linking these admitted reasons to the traditional paradigm in such a way, that they are treated as non-refutable evidence for "explaining the social exclusively out of the social". Three arguments strongly undermine the validity of this alleged implication.

Let us firstly assume that society is in some way or another an autopoietic system and that symbolic communication represents the cement of such a system. Does this provide evidence for the traditional paradigm? Zierhofer (2008a) for instance argues that this is not the case. A different explanation of the autonomy of the social with the support of systems theory can be provided. Self-organization and self-constitution are attributes of autopoietic systems. The environment becomes relevant for such a system, insofar as it must observe its environment to be able to distinguish itself from it. Hence, the existence of an environment is, by definition, an essential element for any system. We take this to be undisputed within a systems theoretical approach. The disputed question, however, focuses on consequences for social theories. If we start from the traditional methodological paradigm, then we are not allowed to accept the 'environment' as explanantia. Our concern here is whether the properties of an autopoietic system provide evidence for the paradigm in question. It does not! Given its properties we cannot exclude the environment from entering our social theories as explanantia. As a matter of fact, human systems do not only communicate symbolically or interact with other human systems,

[3]This methodological postulate is normally understood as an exclusion of any biophysical aspect in an explanation of social structure, i.e. that social facts must *exclusively* be explained by other social facts. An alternative reading of Durkheim will, however, easily find these parts in his work, where he was confronted with the relation between social and biophysical aspects while describing the social facts. Besides characterizing social facts he also coined the term 'social morphology', meaning all things and material objects of society. For him, society is composed not only of individuals but also of material objects (Durkheim 1984: 93; Gross 2001; Jahn and Wehling 1998).

they also need natural resources for their constitution. (cf. Durkheims “social morphology”!) Moreover, the observation in question is not only cognitive, but also interactive – and concerned with how to intervene. Hence, building upon this argument, a new understanding of the “autopoietic” (or ‘autonomous’) arises. An autopoietic system is neither fully determined by its environment nor is it fully detached from it. Rather, such systems have options for autonomous operations while they are geared towards the environment. This amounts to saying that societal order is, also orientated on conditions of the environment.

A second argument arises from our assumption: The theory of autopoiesis may be linked to a theory of emergent properties. Accordingly, the properties exemplifying the autonomy of the social should be understood as emergent and the social structures they constitute as emergent phenomena. Taking this as a starting point for our argument, what follows with regard to our methodological paradigm? Although there isn’t a generally accepted theory for emergent properties, there is an agreement as to its theoretical basis. All emergent properties are understood to emerge from an underlying basis (Kim 2006; Stephan 2005). Accordingly, we gain a strong argument against the alleged link between evidence in favor of the autonomy of the social and its support for the methodological paradigm. It is not plausible to assume that the emergent autonomy of the social is fully free of any natural elements, simply, because it emerges by definition upon such elements. Hence, we can understand autonomy without committing ourselves to the strong traditional methodological paradigm.

A third argument stems from a standard social science approach for human action. An action is normally thought to be constituted by its intended goal or its meaning (together with some background knowledge), its means, decision, realization and its effects. Houses, infrastructure, agriculture, production, etc. are products of our actions using environmental resources. Is it possible to achieve the intended ends of infrastructure and products of all kinds without taking into account the properties of these resources? As resources are means to achieve ends, it is rather the case that their properties provide the framework for actions. Accordingly, action – one of the most crucial notion in the social sciences – transcends the domain of the social without losing its character as a social notion (Runggaldier 1996). Whilst actions certainly display autonomy or self-organization, they are not decoupled from the biophysical environment.

These three arguments strongly undermine the alleged implication between autonomy and the traditional methodological paradigm. We conclude accordingly that there are good reasons to claim both that the concept of the autonomy of the social should be sustained and that the traditional methodological paradigm is insufficient to cover the functions of social sciences (Burger 2007; Zierhofer 2008a): Social life can only be adequately explained if biophysical aspects are integrated into the explanations (Zierhofer 2002, 2008a; Zierhofer et al. 2008).

What do we understand by “biophysical environment”? We define as such all the elements that exist in the environment of a human actor, that follow at least partly their own causal and functional regularities and, which accordingly, exert resistance against our activities in one way or another. The resistance we have in mind restricts our space for action. We cannot for instance seriously claim that shooting a deer will not cause its death or that cutting down trees will not cause their falling. We can prevent floods, but we cannot seriously claim that the causal forces water exerts on its environment may be any different on earth than they are. Although the entities may be shapeable, the physical or biological qualities are shapeable only on a limited scale. Examples are the human body, the earth's water cycles, causal interactions between substances, that NaCl is soluble in water, etc. The definition we propose is rather weak because it only focuses on physical and biological qualities. It is also – astonishingly enough – in full accordance with statements by Durkheim and Weber (Gross 2001: 43–49). If we are now going to present an alternative methodological paradigm integrating the biophysical environment, no stronger conceptual commitment to "biophysical environment" is made than expressed in our definition.

An alternative paradigm emerges by allowing an addendum to the traditional (Burger 2007). Social facts could be explained by other social facts or by a combination of social and non-social facts. By including such an addendum we gain more explanatory power especially in the field of environmental sociology or sustainability sciences. The explanation of social facts exclusively by non-social facts would still be unacceptable.

The consequences in regard to naturalism – the well-known standard objection against including biophysical aspects – are evident enough. Naturalism is normally treated as a reductive theory – at least within our field in question. A theoretical approach to a social phenomenon is naturalistic if, and only if, it exclusively accepts findings and terms from natural sciences to explain the phenomenon in question. Does it follow on the background of that standard definition that a social scientist is committed to naturalism if she is willing to integrate findings and terms from the natural sciences into our understanding of modern societies? We are not able to see why this should be the case. Integrating such elements and reducing the social to such elements do not amount to the same thing. Hence, our proposal for a transformed methodological paradigm, which will allow integrating biophysical elements as explanatory elements within social theories, is not committed to naturalism.

We recall Catton and Dunlap's effort (1980) to give voice to the ecological aspects within social science. They not only already revealed the theoretical and academic relevance of ecological issues and challenges for social sciences at an early stage, but also argued that too radical a conception of the autonomy of the social leads to what they called "human exemptionalism paradigm" (HEP). Although HEP is basically taken as a strong anthropocentric societal paradigm that sees humans as removed from ecological constraints, they identified a strong link between HEP and the methodological paradigm developed in sociology's early stages. They argued, as do we, that following this paradigm renders the social sciences ill-prepared for analytically coping with the demands which stem from ecological challenges. As a consequence they encouraged social scientists to develop a "new ecological paradigm" (NEP) to prepare a paradigmatic break from human exemptionalism.

Even though they did not develop a theory for human-environment-interrelations itself, they claimed that a dialectical understanding between society and its biophysical environment, ”the impact of human societies on the environment and the impact of environment (ranging from “built“ to “natural“) on social organizations and human behavior“ to be crucial for the emergence of a “true environmental sociology“ (Catton and Dunlap 1980: 32). They classified studies on public attitudes or awareness towards environmental issues, studies of membership in environmental organizations, problems faced by resource management as comprising a simple ”sociology of environmental issues“ (ibid.) and as still being committed to a HEP-perspective. A “true” environmental sociology would allow an examination of the relationships between social and environmental variables and the breaking of the traditional taboo against including non-social variables in sociological analysis (ibid.).

One of the difficulties of their approach is that the idea for a NEP and the methodological paradigm for social sciences do not lie on the same theoretical level. NEP or HEP are both dependent upon a methodological paradigm, but do not constitute methodological paradigms themselves. The very perspective for a NEP is dependent upon an alternative methodological paradigm. By reformulating the basic methodological paradigm for social sciences, we open the door for what Catton and Dunlap called a “true environmental sociology”. Now, we have to go a step further and construct the house around the door.

Societal Metabolism

There are several theories that try to describe the interrelation between the social and the biophysical environment. Among them, we consider the interdisciplinary concept of societal metabolism (Fischer-Kowalski and Erb 2006) to be the most promising. The concept has been continuously developed for more than 10 years now, has been proven to govern empirical research and has been heavily criticized as being naturalistic by mainstream sociology. Our interest lies in both rejecting the criticism as inadequate and providing important desiderata within this theoretical approach.

Societal metabolism is understood to mean the exchange of energy and substances between society and environment. It provides a macro-structural and functional view on societal and natural coherences. Human population, complete with artifacts and companion animals, is conceptualized as an intermediate element between nature and culture. The concept of the “colonization of nature” captures the intended influence of a society on natural processes against the backdrop of a Marx-oriented understanding of labor. Hence, colonization is considered as societal action, and as a kind of organizational work (Fischer-Kowalski and Erb 2006; Fischer-Kowalski and Weisz 1998). In their historic perspective, the socio-ecologists from Vienna and the historian Rolf Peter Sieferle from St. Gallen focus on societal metabolism’s changes under different social-ecological regimes.

Social-ecological or societal metabolic regimes describe different social constellations and the society-nature-interrelations (Krausmann and Schandl 2006). Social structure and institutions together with working processes regulate the specific metabolism within a social-ecological regime. Changes in regimes effectively amount to concurrent changes in the social metabolism. The authors assume a co-evolutionary development of social and natural systems and view them to be structurally coupled. They distinguish between three types of regimes: (1) a regime of uncontrolled use of solar energetic flows of hunter-gatherers; (2) a regime of controlled solar energetic flows of agrarian societies; and (3) an industrial society's regime with fossil energy (Krausmann and Schandl 2006; Sieferle 1997; Weisz et al. 2001). Each of the regimes has metabolic limits according to the potential of its used resources. Within these limits societies try to optimize their use of resources.

Let us first consider their critics: Jobst Conrad, for example, argues that the concept of societal metabolism cannot be considered an environmental sociological approach as it only partially explains social facts with other social facts (1998: 48). This argument is only convincing if it is the case that the traditional methodological paradigm holds – if not, as we argue, it no longer holds as an argument. Additionally, he claims that the ecological crisis becomes only effective for social scientists in the context of societal perception, interpretation or with regard to risk management of the environment (Conrad 1998). Consequently he argues that the sociologist's task is to analyze environmental issues. The argument is mistaken, however. Firstly, the concept of societal metabolism tries to analyze the structural bindings between societies and biophysical environment regardless of the additional question as to the existence of an environmental crisis. Secondly, whilst Conrad is certainly right in claiming that talking about an ecological crisis reflects societal perception, we question why an analysis thereof should be restricted to societal perception alone? Do we wish to claim for example that the normative content of sustainability or scientific risk assessments in general are dependent upon societal perception? There is no point in claiming this. Hence, there is no point to restrict societal analysis to perception, interpretations and the like.

What if we were to accuse the concept of metabolism of being naturalistic? Becker and Jahn (2006: 135) claim that understanding societal relations on nature as metabolism would mean to naturalize the nature-society relation. Firstly however, the argument does not fit to the standard semantic understanding of "naturalize" as given above (cf. Burger 2007). Cordula Kropp puts forward a different concern, focusing on colonization (Kropp 2002). She interprets the naturalistic attitude within "societal metabolism" to explain why societies do not determine their degree of colonization themselves, but rather that colonization "naturally" grows. In other words, she criticizes societal metabolism as kicking autonomy out of the social domain and seeking to describe human societies in the same way as ant societies are described. But does that interpretation really fit to the metabolist's concept of colonization? The advocates of societal metabolism define colonization as intended social action and as a kind of organizational effort or working process. They refer explicitly to Marx's term of labor. Moreover, they also refer to Luhmann's theory of symbolic communication to conceptualize social processes

(Brand 2008; Fischer-Kowalski and Erb 2006; Fischer-Kowalski and Weisz 1998). The structural coupling between social and biophysical elements within processes of colonization thus displays autonomous and non-autonomous elements. Hence, Kropp's argument fails. The degree of colonization is not naturally given: The social and the natural system are indeed coupled but the social system is by no means uniformly determined by the biophysical environment. This leads us to conclude that all fundamental criticism relies on the traditional methodological paradigm. By rejecting it as we suggest, the objection that the theory of societal metabolism could not explain social facts vaporizes.

According to our interpretation, the concept of societal metabolism can be considered an approach to a new environmental sociology in line with Catton and Dunlap's NEP. There are, however, a couple of weak elements within the concept as it has been developed so far. Although the term "regime" leads us to expect an analysis of the socially structured regulation of energy and material flow, the analysis of regulations still remains in need of further development. The same is true for labor organization. Moreover, the term 'population' remains rather critical. Although the term may be useful from a macro point of view, it certainly does not capture social structure. In action theory interactions, organizations, and institutions are considered to coordinate actions. The concept of societal metabolism has so far paid little attention to the way this metabolism is organized (Zierhofer 2008b). As the concept focuses mainly on a historical and macro-structural view of the interrelations between society and the biophysical environment, the impact of social structure within this working process and the connection between social order and biophysical environment still need to be further analyzed. For instance we learn that an agrarian society is a different social metabolic regime to that of an industrial society, or that a village has another type of metabolic flow than a city (Sieferle et al. 2006; Zierhofer 2008b). However, we do not sufficiently learn how these social entities are structured and organized. There are important desiderata with regard to the way regimes are socially structured or to the way in which regulations are developed.

Ecological Regimes

The concept of societal metabolism provides a framework for how society and biophysical environment can be theoretically put into relation. Although societies are dependent upon ecological resources, societal metabolism also always displays organization, structure, intention (or interest), and labor (or action), i.e. autonomy with regard to the use and treatment of ecological resources. The analysis of organization, social structuring, etc., however, has so far been underdeveloped within strongly macroscopic oriented research on societal metabolism. We see our conceptual scheme "ecological regimes" as a contribution to filling this gap. We endeavor to provide a concept for the level of institutional structures which not only allows us to integrate the biophysical environment into social theory at the aggregated organized action level, but also to demonstrate empirically the mutual influence that biophysis and societies exert upon each other.

The concept “regime” also takes a prominent role other in socio-ecological theories (Becker and Jahn 2006). The rational – among others – certainly is that human-nature relations do not just happen in highly differentiated societies. They are, or even have to be, organized. We can generally say that society is formed by regimes, where a ‘regime’ expresses, in a first tentative approach, organized regulations with regard to a specific domain. A regime always has a twofold character. Its regulation defines, on the one hand, the frame conditions for human activities within the domain in question. The regulation is, on the other hand, the result of human actions, because it is defined, transformed and redefined by organized actors. As organized social actions are normally regulated, a regime also always displays regulated social action. Eventually, we call a regime ecological if the domain in question touches upon social-biophysical interrelations (e.g., resources, living spaces, ecosystems). The explicit use of the term “social” is hereby crucial. A specific ecological regime is not restricted to regulations concerning an ecological domain (let’s say such as water), but always includes social structure (organizations, structures, etc.) as well.[4]

Let us introduce a rough example of what we have in mind when we refer to an ecological regime: water regulation. In the nineteenth century, floods often threatened people’s lives. Moreover, wetlands covered remarkable portions of potentially usable land, be it for settlement or agricultural production. Against this backdrop, the canalization of rivers became the core idea for a new river-regime. In order to prevent further flooding and to gain new land, it was decided that rivers should be canalized and their courses should be corrected. Technologies to restrain rivers were invented and new knowledge thereby acquired. Policies and laws emerged defining responsibilities and duties. Actors formed organizations to articulate their interests and to influence regulations through negotiations or in their power structures. As a result of the new regulation the landscape together with the intervening society changed. These results, however, did not only offer new opportunities for societal development but also create new risks for the regulating societies.

We are for instance quite familiar with the new risks that can arise regarding rivers. Despite all efforts, floods have not been successfully prevented. In addition, new challenges have emerged such as issues around water quality, biodiversity, urban sprawl, etc. The ecological ‘water regulation’ regime has thus also started to change. In the 1970s the leading idea and knowledge within hydraulic engineering changed from being focused upon restraint to a more holistic view of revitalization and renaturation. Preservation and maintenance of floodplains were re-discovered as natural prevention against floods, river-courses were re-corrected, new dangerous

[4]We kindly remind the disputants of the fact that the meaning of a term is given by a definition. In the same way as ‘societal metabolism’ doesn’t have the same meaning like ‘physiological metabolism’, ‘ecological regime’, defined in terms of human action, it may look like the same locution as used by hydrologists or biologists, but has a fundamentally different meaning.

zones for settlement identified, etc. Laws, instruments, societal organization and affected and engaged actors all began to change accordingly.

By systematizing such examples we are able to further develop our notion of an ecological regime. An 'ecological regime' is a complex structured theoretical concept representing following elements as its constituents:

(a) The inherent dynamic of the regulated part of our biophysical environment: The example above shows that biophysical structures have an influence on social structures in the sense that society and its technology interact vis-à-vis biophysical structures. Biophysical structures also have an inherent dynamic on their own which make the effects of regulation an open-ended endeavor.

(b) Regulation: Laws and other political instruments certainly are basic elements of any regulation. The example, however, also reveals that regulation consists of a lot more than only laws or political instruments. In addition, a "regulative core idea" such as canalization for instance, governs the regulation in question and accordingly, belongs to it. Moreover, the societal organization is a constitutive part of regulation, because the latter calls for societal organization. Hence, the ways in which interventions become defined (such as negotiations, top-down planning and power) and how regulations are enforced through (police, economically, etc.) also belong to regulation. Ultimately, regulations display potentials and feasibility for human interventions.

(c) The actors involved in regulation: Regulation is realized within institutional networks built for instance by economics, politics, justice or sciences. There are major differences with regard to the actors involved in water regulation in the nineteenth and the late twentieth century respectively. Whereas NGO's, international organizations (like the World Bank) or water authority agreements ("EU-water framework directive") may play important roles in more recent projects, this will not be the case for classic top-down projects in the nineteenth century. It goes without saying that the actors in question represent interests, knowledge, social and material resources (power) and the like. To obtain their aim, actors have to gain an idea of the situation of social and physical facts. They need information to verify their goals, to choose their means of action, to plan the action and to calculate the risks involved. Hence communication, or better argumentation, between actors plays an important role. Regulations are based on argumentative reasoning. Ultimately, those who are excluded but affected by the products – such as the peasants during the big water correction program in the nineteenth century – are also part of a specific regulation scheme.

(d) The social structures interwoven with the regulated biophysical domain: The small Swiss cantons for example were not able to cope with the challenges stemming from flood problems during the first half of the nineteenth century. The floods crossed the borders and the jurisdiction of the cantons, whereas the constitution of the federal state in 1848 improved their action capabilities. Furthermore, there are concerns regarding justice. (How are risks and opportunities distributed?) To put it in more technical terms: The functional subsystem(s), social stratification, and the level(s) of decision making (communal, regional, national, etc.) are constitutive elements of a regime. They not only affect regulation, but are also affected by the effects of regulation (e.g., less but more intensive floods).

(e) The social and biophysical consequences of regulations: Firstly, the biophysical environment will be rebuilt (or sometimes protected) according to the regulation's potential and feasibility. Secondly, new social structures, e.g., settlements or new enterprises, will emerge alongside the changed environment. Thirdly, however, new risks can emerge in addition to new opportunities. Risks and opportunities are distributed on both sides, on the social as well as on the biophysical. The consequences represent analytically the recursive link to the inherent dynamics of both the social and the biophysical.

We do not have enough space to further develop the sketched complex structure of our concept. There are some fundamental traits, however, which are worthy of explicit note. Firstly, standards of today's sociology are integrated. Decisions, actors, organizations, values, power and the like are constitutive elements in regimes. Secondly, there is a fundamental difference to standard HEP-sociology. Ecological regimes contain mutual interacting social and biophysical orders. Here, we are entering the world of a NEP. The social not only shapes or reacts to its environment but it also orientates itself with regard to its properties. Floods, the difference in energy density between wood and coal, growing CO_2-concentration in the atmosphere all contribute to explanations around the development of modern societies. Biophysical properties and structures can make social structure possible (or impossible in the case of an earthquake!), in the sense that they deliver the frame conditions which shape our social world. Thirdly, the concept displays the inherent dynamic between the social and its environment by taking into account the dynamic factors on both sides. We do not, claim that biophysical structures constitute social structures. The social still follows its own grounds for organization such as communication, following rules or norms, or actions. We take into account that communication, norms, or values, and action refer to something in our environment, which is strongly dynamic. Optimization or facilitating the execution of an action both call for greater orientation within the specific biophysical conditions.[5] Our term orientation represents the two sides of the coin we have in mind: one has to take the qualities of the biophysical environment into account and by doing this one also creates specific independencies for social life. The classic view in social sciences concedes human action to be an influence on the environment, but that biophysical environment itself is dynamic and influences human interaction, has not been sufficiently considered. Especially on an institutional level there exists no theory of societal relations vis-à-vis the environment. The concept "Ecological Regimes" allows us to start explaining this relationship and fills a conceptual gap. To sum up, we can say that the structuring elements of ecological regimes are the dynamic biophysical environment with its restrictions for human actions on

[5] Weichhart (2003) followed a related approach in action-setting theory. The theory describes how subjects in a certain context orientate in relation to biophysical conditions to realize their aim. In terms of systems, action settings consist of actors, material structures and a program setting.

the one hand and regulations, actors, social structures and the regulation's consequences on the other. These elements also display negotiations and power structures in ecological regimes.

Perspectives

With our theoretical concept 'ecological regimes' we have strived to conceptually integrate the biophysical environment into aggregated societal structures and complex human interactions, while underlining the regulation of environmental relations. The autonomy of the social is maintained because societal structures are conceptualized to orientate themselves vis-à-vis the condition of the biophysical environment – particularly with regard to the laws of nature, the attributes of material, or the dynamics of living spaces – without being determined by them. The classic standards such as symbolic communication or value-oriented action are treated as sine qua non for regulations. Moreover, by adjusting social structure in accordance with biophysical elements, the biophysical environment becomes part of society – and hence has to feature in theories of society. To capture the interrelations between the social and the biophysical environment systematically and adequately, we proposed an adaptation of the classic methodological paradigm and admit an explanation of social facts by social facts under inclusion of biophysical aspects.

An important criterion for a theoretical concept is whether it guides empirical research in a fertile manner. Empirical research will reveal how, and to which degree, the structural coupling between institutions and their biophysical environment functions. To this end, we are currently analyzing the forest and the water regimes of the last two centuries in Switzerland. If the concept of ecological regimes describes interrelations between the social and biophysical world adequately, then the dynamic processes exemplified in our five categories should be identifiable within our empirical cases. If so, we can be seen to have contributed to the development of a NEP orientated societal theory and to having identified an important docking point for collaboration between the social and natural sciences.

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Part II
Exploring Limits and New Possibilities for Understanding Environmental Rationalities

Chapter 6
Understanding Responses to the Environmental and Ethical Aspects of Innovative Technologies: The Case of Synthetic Biology in Europe

Steven Yearley

Abstract Using the case of recent concern in Europe and elsewhere over the possible societal and environmental implications of synthetic biology, this chapter examines how claims about the implications of innovative techniques and procedures are typically made. The analysis suggests that claims are characteristically couched in terms of a dualism: what is factually possible and what is ethically desirable. Use of this is/ought dualism serves *both* to reproduce the division of labour between natural scientific knowledge of what is and ethical knowledge of what should be *and* to indicate that, between them, science and ethics exhaust all the knowledge that is relevant to the assessment of innovations. The analysis goes on to show that this twofold classification is inadequate and that using this twofold approach has tended to limit the kinds of question about societal and environmental implications that get to be asked officially.

Keywords Synthetic biology • Is-ought dualism • Fact-value distinction • Innovation • Ethics

Introduction: Synthetic Biology: Engineering the Natural World

In the last 5 years, scientific and policy interest in synthetic biology has grown enormously, to the extent that some commentators now view this field as the potentially most significant – and not just the most recent – in a series of major potential technological challenges to environmental quality (ETC Group 2007). The idea behind synthetic biology is that, with vastly enhanced understanding of genetics and an appreciation of how the genome works, one can begin to move towards

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engineering-style approaches to biology. Hitherto, biological systems have not been easy to manipulate in predictable ways. For example, conventional plant breeding depends on breeders taking plants with desirable characteristics and crossing (and re-crossing) them with other plants until the sought-after features stabilise. One does not know how many crosses this will take and even whether the desired attributes can be produced. It is hard to get plants to produce new, attractive characteristics and ‘classical’ breeders had to resort to extraordinary means to produce mutations unless these happened to be forthcoming by chance. To provoke mutations, plant material was dosed with chemical mutagens or exposed to radiation in order to stimulate genetic alterations that might just be useful. This was a lottery – sometimes a profitable one – but not design engineering.

For approximately the last 3 decades scientists have been working on the techniques that underlie what are now known as genetically modified plants and seeds. In North America this approach is often referred to as ‘genetic engineering’ (GE). Without for the moment touching on the widespread controversies around GMOs, these GMOs did seem to offer a technical advance on earlier approaches since one had more control over the outcome of genetic change. Ideally, one would take genetic material that coded for a particular outcome in a known species or variety (which did not even have to be a plant) and then introduce this into the host genome. Thus one could get a corn (Bt-maize) to produce a protein, normally created by the *Bacillus thuringiensis* bacterium (but not by any known corn), that will attack the gut lining of certain caterpillars and eventually kill them. Or one could take the gene that makes certain jellyfish fluoresce (on account of green fluorescent protein), and insert it into other species to get them (or specific tissues within them) to glow green in dark conditions when gently lit with blue light.

Although this approach is sometimes called GE, one could reasonably query its qualifications as a branch of engineering. As critics of GMOs liked to point out, these approaches to genetic modification still had a large element of chance. One did not know where exactly on the genome the introduced gene would end up; one did not know precisely how the new gene would operate in its new context nor precisely what impact this genetic material would have on neighbouring genes. The host genome was not ‘re-written’ with the inserted material in; rather the new gene was often ‘fired’ into the host DNA in the hope it would ‘stick’. A lot of the more sophisticated controversy around GMOs was predicated on this unplanned aspect of the gene’s placement (see for example the account in Levidow 2001: 857) and it is still widely publicised on Internet sites.

Synthetic biology offers itself as the realisation of the engineering ambition for biology. It does this in two main ways. There is firstly the sense that it is now easier and far cheaper to compile stretches of DNA so that, in principle at least, genetic material does not need to be made up of long strings culled from elsewhere. It can be written to order. Second, methodologies are being developed that allow the production of standardised parts for genetic assembly, genomic ‘components’ whose characteristics are intended to be well understood.

To date the most well known exemplar for this standardisation is associated with the ‘biobricks’ approach, itself strongly associated with MIT. Often said to be like building with a Lego-set of standardised ‘bricks’, the idea is to produce a collection of relatively small genetic components that can be put together in innovative ways. A better analogy is probably with electrical components, with resistors and capacitors and so on, where using the same fundamental elements one can make an amplifier or a radio receiver or myriad other products.

This approach has been successfully publicised through the annual iGEM (international Genetically Engineered Machine) competition which involves teams of undergraduates and even high-school students across the world in a contest to develop the ‘best’ new engineered system. The competition depends on a register of components on which the teams can draw, but participants also contribute to the development of the parts registry. There is an interesting question about intellectual property in relation to such a shared-registry of parts since one obvious way to develop this initiative is in an open-source manner with all new components fully described and characterised on widely available websites. But at the same time there is an awareness that, in principle at least, applications of some of these components could be of enormous commercial value which weighs against a desire to lodge information in a freely accessible manner.

The second well known strategy for developing the synthetic engineering of biology is associated with Craig Venter. Venter’s route has been to try to identify the smallest viable genome. Instead of using the Lego analogy, Venter favours a computing analogy: his idea is to identify the simplest operating system for life. The approach here, essentially, is to find very small natural genomes (for example in bacteria) and then ‘knock out’ various components to see which sections are dispensable and which are not. One should then be able to identify the smallest viable genome; and this can become the vehicle for adding other genetic components to perform particular tasks. Venter’s approach avoids any ambiguity over intellectual property since the idea is to control the IP in relation to the central biological operating system and to the components which are added to it. Venter often refers to his approach as synthetic genomics.

Whether one adopts the biobricks or the minimal genome approach, the aim is to engineer biological systems so as to develop new products and perhaps thereby to meet current environmental and medical/pharmaceutical challenges. For instance, in 2007 Carlson et al. reported on a technique for assembling ‘minichromosomes’ and introducing them into maize; according to the authors ‘This novel approach for plant transformation can facilitate crop biotechnology by (a) combining several trait genes on a single DNA fragment, (b) arranging genes in a defined sequence context for more consistent gene expression, and (c) providing an independent linkage group that can be rapidly introgressed into various germplasms’ (2007: 1965). In other words, rather than insert genes one-by-one using a rather scattergun approach, numerous genes can be added at the same time, in a repeatable and preplanned sequence, and in such a way that they stand a very good chance of being heritable over successive generations. The ambition is thus that novel desirable characteristics can be engineered into new biological entities. For example, one candidate application for biobrick-generated organisms is the identification and remediation of contaminants; they would be engineered to detect and break down the contaminant. For his part, Venter has suggested that synthetic organisms could be created that would sequester carbon from atmospheric carbon dioxide while others could generate energy in the form of hydrogen.

Shaping Regulatory Concerns Around Synthetic Biology

It is widely acknowledged that for most significant innovations in science and technology a subtle balance needs to be established when it comes to the governance of new knowledge and novel products (see the series of studies since Nelkin 1979). Proponents typically make strong claims about the novelty, excitement and potential impact of their emerging field or area of technological advance. This reflects the genuine enthusiasm they feel for their projects, but also helps to mobilise funding and investment, and to excite political support (see Wright 1994: 115). There is always competition for research funding and for investment by universities, and new areas can only win significant backing through insistence and clear claims about the rewards they can bring. Vigorous efforts have to be made to establish new laboratories, research units, journals and funding streams, particularly in interdisciplinary areas such as synthetic biology which fall between the biological and the physical sciences. At the same time, the more novel the area, the greater the potential demands for regulatory intervention can be (see Jasanoff 1990: 2–9). In turn, innovators are generally anxious about excessive regulation and therefore their claims about novelty are commonly complemented by assertions that regulatory issues are negligible or have already been taken into account.

Synthetic biology conforms to this generalisation very well. As outlined above, the area can make a very plausible case for its innovative qualities. Of course, the science itself has great novelty. The idea of finding a minimal ‘operating system’ for life for example, or of investigating how biological parts function in novel ‘circuits’, or even of creating living cells and cell systems based not on DNA but around peptide nucleic acid (PNA) chains need no exaggeration or rhetorical boosterism to appear highly significant (see Tucker and Zilinskas 2006). But there are also additional ways in which synthetic biology’s novelty is manifest.

There is firstly the matter of the potential applications of the technology. Though the potential uses in the short term seem limited (and mostly to resemble existing techniques of genetic modification), proponents offer post-petroleum visions in which highly innovative biological systems are engineered to produce hydrogen or other fuels. There are also ideas about the engineering of biological systems to synthesise medically important molecules and even to deliver them to specific locations within living organisms. These and other ideas feature, for example, in the European Union’s NEST Pathfinder Initiative on Synthetic Biology (see below): other suggestions hinge on developing bacteria or other simple biological entities that can clean up environmental toxins or remediate contaminated land. These applications could make synthetic biology into a far more pervasive technology than mere genetic engineering. In a period when governments the world over are concerned about finding technological routes to avoid carbon dependence, the idea of efficient biological factories for hydrogen production is inevitably attractive.

Alongside these ideas about practical interventions there is also a procedural novelty about synthetic biology: the way that it can take advanced genetic engineering to the 'garage' level. At least among some exponents – and in a sense institutionalised in the celebrated annual iGEM (international Genetically Engineered Machine) competition which, as mentioned above, involves undergraduates and even high-school students across the world – one finds the idea that genuinely novel work can be done by relatively untrained people using commonly available equipment and materials. Just as in the world of IT and electronics where a number of powerful and commercially successful initiatives have been inaugurated outside the academy and beyond the walls of established corporations, synthetic biology could potentially be undertaken by enthusiasts in informal 'laboratories'. As commercial sources of oligonucleotides proliferate and as DNA synthesisers fall in cost and rise in speed, the feasibility of these claims only increases (see de Vriend 2006).

The exact implications of this potential are contested and, in detail, unforeseeable but in the IT world such garage practitioners have given rise to enormously innovative firms and tremendous creativity, as well as to hackers and persistent distributors of viruses. There seems no reason to suppose that biological research could not develop along similar lines. And the already-demonstrated capacity to synthesise actual viruses from biological precursors (as early as 2002 researchers in New York assembled polio viruses from components bought over the Internet [see Tucker and Zilinskas 2006: 27]) suggests that the unwanted side of this move to 'garage production' is as likely as the positive one in the case of synthetic biology.

Thus, in the case of synthetic biology there are strong arguments about the scientific and intellectual novelty of the area, about the potential sorts of applications which could likely result, and even about the wide range of potential practitioners that could become involved. But directly corresponding to each of these is a kind of regulatory concern. If the entry barriers are low for a form of scientific practice with dramatic implications then – arguably – the need for regulatory control over access is great since no one wants unlicensed operators releasing experimental organisms. If there are likely to be extensive opportunities for application within the human body and in the open environment (for energy production or novel forms of bioremediation) then the release and safety-testing implications are potentially enormous. Lastly, if this technology does give people new power over the fabrication of entirely new forms of life then this might eclipse the public disquiet over granting licenses for experiments on admixed embryos which was so conspicuous in the UK in 2008 or persistent worries over the treatment of embryonic stem cells in Germany, Italy and the United States.

Although I consider that these claims about the intellectual and practical aspects of synthetic biology are plausible, in a sense my argument does not depend on any of these claims being correct or highly probable. Rather, the point is that once these assertions about far-reaching novelty or widespread applicability are made, the regulatory implications are hard to avoid. The more strongly the claims are put forward, the more powerful the apparent regulatory logic. Proponents of synthetic biology need to make claims about its startling novelty and wide-ranging implications if they are to win support, yet they cannot make these claims without simultaneously raising questions about suitable safety and regulatory standards.

In this case the regulatory demand has been recognised and acknowledged within the synthetic biology community (or perhaps ‘communities’) itself. In the UK and Europe the analogy with the public controversies over GMO plants and foodstuffs has been widely noted. There is a concern to avoid the polarisation of views which characterised that controversy (see Yearley 2005a: 159–174). In the US the analogy with the Asilomar Conference on Recombinant DNA in 1975 has been at least as much to the fore, and the topic has also been widely discussed in the light of the increased terrorist threat this century and the response in terms of Homeland Security and the regulations that go with it. As is well known, a key feature of the Asilomar meeting in the 1970s was that the scientific community developed its own protocols on biosafety in advance of external regulation. The meeting of the leading scientists succeeded in putting forward its own biosafety methodology; essentially the proposal was to match the containment strategy to the level of risk posed by the material being worked on, using a straightforward classification of risk levels (Bennett et al. 1986: 12). At Asilomar they also advanced ideas about how a national policy advisory body should be constituted: as an advisory body to the (US) National Institutes of Health (Wright 1994: 154).

Already, ethical and social issues relating to synthetic biology have been acknowledged by many of the leading research bodies, and some forms of ethical reflection have been set up to accompany research initiatives. The European Union has a large ‘NEST Pathfinder Initiative’, funding bids that were presented in 2004. Alongside the 16 research projects there was a funded project entitled Synbiosafe dealing with regulatory issues. In the USA, the National Science Foundation’s ‘Synthetic Biology Engineering Research Center’ (SynBERC) has a human practices ‘thrust’ (alongside thrusts on chassis, on parts and on devices). Even iGEM now includes a component on ethical and social reflection and in the UK the most relevant research funding council (the BBSRC) commissioned its own social and ethical challenges review (Balmer and Martin 2008). Clearly, it is impressive that the awareness of the possible implications is sufficiently advanced that researchers and funders have taken these initiatives, though of course it is also a smart move in pragmatic terms both to anticipate regulatory review and to display one’s concern with such matters. As Wright noted of the intense debates at Asilomar, ‘Being regulated by one’s colleagues troubled some researchers, but that it might pre-empt externally administered controls acted as a powerful pressure toward achieving consensus’ (1994: 153).

As an illustration of the recognition given to regulatory issues, in his 2007 UK tour to promote his then newly published autobiography (2007), and thus his whole synthetic biology enterprise, Craig Venter responded to concerns about the societal and human implications of his version of synthetic biology by, among other things, noting that he and his colleagues were alert to these issues, even to the extent that they had commissioned a review – published in *Science* – of 'Ethical considerations in synthesizing a minimal genome' (Cho et al. 1999). Commissioning one's own ethical review is indeed an uncommon move for a research scientist to make.

It appears that all the participants in this evolving techno-scientific field acknowledge that there are questions around the societal implications of introducing such technologies, including environmental impacts and their implications for developing countries. My interest in the next section is in the way that this concern is commonly framed, not least by scientist-proponents of synthetic biology.

Reading Synthetic Biology in Terms of 'Is' and 'Ought'

It is a fundamental commitment of mainstream analytical philosophy that one needs to distinguish between questions of what exists ('is' questions) and questions of how one should act ('ought' questions). The fact-value distinction as it is also commonly known indicates that the former is the domain of empirical investigations while the latter is properly the territory of ethical inquiry. Although many philosophers who might be expected to endorse this distinction now accept that the fact-value divide is not as sharp as it was often assumed to be, there is still a sense in the modern – or at least pre-postmodern – world that facts are brute and unarguable. However discomforting a fact may be, it is a fact irrespective of our feelings about it. If young women are in fact educationally more successful on average than young men, as recent examination score trends appear to indicate, then this is the case whatever our egalitarian preferences would have us believe. By contrast, matters of value are open to continuing dispute. Whether liberty is to be prized over equality is an issue about which we accept a clash of opinions (see Putnam 2003).

This way of dividing the world of knowledge into two enormous and mutually exclusive domains,[1] is commonly very attractive to scientists. One much cited example which gives a good flavour of how this divide is viewed comes from Ian Wilmut, the scientist responsible for Dolly the 'cloned' sheep. In his popularly successful book about Dolly entitled *The Second Creation: Dolly and the Age of Biological Control*, Wilmut sets out the sorts of things that we *can* do as a result of cloning by nuclear transfer from adult somatic cells and the sorts of things we are very likely to be able to do. The question remains he says of what we *should* do. He asserts that:

> Those future technologies will offer our successors a degree of control over life's processes that will come effectively to seem absolute. Until the birth of Dolly, scientists were apt to declare that this or that procedure would be 'biologically impossible' – but now that expression, biologically impossible, seems to have lost all meaning. In the twenty-first century and beyond, human ambition will be bound only by the laws of physics, the rules of logic, and our descendants' own sense of right and wrong. Truly, Dolly has taken us into the age of biological control' (2001: 5).

[1] According to the views of analytic philosophy other forms of knowledge may exist too, such as aesthetics.

This approach draws upon – and simultaneously recreates – the pivotal distinction between, and the primary status of, the two forms of knowledge: scientific knowledge of what is and ethical understandings of what should be. From the point of view of natural science, the fact-value distinction provides a sense of the monopoly that science has over its proper domain. In Wilmut's view, two of the three things that will set the bounds to human ambition are the laws of physics and the rules of logic – areas where scientists and mathematicians are naturally the authorities. But this distinction also generates a type of knowledge for which scientists have no professional responsibility: people's 'sense of right and wrong'. Furthermore, by approaching the topic in this way, it becomes clear that 'ethics' (the study of right and wrong) gets to be identified with the precise thing that science is not.

I suggest that the heart of this view can helpfully be set out in Fig. 6.1 which shows two existing domains of questioning, each occupied by one form of knowledge. This view of a 'partitioned' monopoly also coincides well with the experience of several social commentators and sociologists who have lately been invited to participate in synthetic biology activities. The role they have been invited to fill – and I write as a case-study example myself – is to comment on the ethical aspects of synthetic biology (Yearley 2009). This is, I suggest, not because natural scientists have been confused about the difference between sociologists and philosophers and have inadvertently contacted the wrong people. Rather it is because, within the epistemological framework of natural science, the obvious label for the area of knowledge about which scientists claim no expertise is 'ethics', the study of oughts and what ought to be.[2]

Accordingly, given the apparent pervasiveness of this point of view and the central position it appears to occupy in thinking about the societal implications of innovative developments such as synthetic biology, a key question concerns the robustness and internal consistency of this perspective. In Fig. 6.2 the diagram is

Fig. 6.1 Is/ought: the canonical model

	is	ought
science	x	
ethics		x

	is	ought	
science	x		not all 'is' questions are answerable at the level of natural science
ethics		x	not all 'ought' questions can be settled through ethical analysis

Fig. 6.2 More on is/ought: inherent limits to the canonical model

[2]Though, as Shapin carefully shows, assumptions about certain oughts were required to frame the original context of scientific truth telling in the seventeenth century; see Chapter 3 of his 1994.

repeated but with key objections to the one-to-one associations between science/is and ethics/ought noted. These objections are considered further in the following sections of the chapter.

The Limitations of 'Is' and 'Ought' in Relation to Synthetic Biology: Is

Two examples will be examined in this section and the next to indicate the limitations that accompany the division of cognitive responsibilities described above. The first one deals with the issue of the environmental and medical/nutritional implications of synthetic biology. The heart of the issue is that, as noted above, key potential applications of synthetic biology could include large-scale biological energy production, biological systems for carbon sequestration and environmental clean-up mechanisms, all of this in addition to possible medical and pharmaceutical uses. For such possibilities to be realised, the technology would have to be deployed widely and not just contained within the confines of a laboratory.

The main issue to cause problems at the level of 'is questions' is not peculiar to synthetic biology, but is familiar also from arguments over GMOs and over nanotechnology. It is that, accepting that these technologies give rise to products that are in a strong sense unprecedented (jellyfish genes have never been in plants before and copper nanotubes are wholly novel), one cannot envisage how to test the environmental and human-safety aspects of their large-scale release without making some assumptions about how those products will behave. And while those assumptions will be scientifically informed, they are not 'facts' in the sense intended in Fig. 6.1. In the case of GMOs, this issue famously rose to prominence in the debate over their nutritional value and safety, specifically in relation to the standard known as 'substantial equivalence' (Yearley 2005a: 166–169 and Chapter 5 of Murphy and Levidow 2006).

In order to work out whether it was safe to license GMOs, some testing protocols had to be agreed. But the protocols could only be drawn up once one had agreed how far the tests needed to proceed. In adopting the criterion of substantial equivalence, regulatory authorities determined that tests could stop at the point at which GM products were substantially equivalent to (non-GM) products that were already licensed and consumed. The regulators made compositional similarity between GM foodstuffs and non-GM products their stopping point. However, rather than settle the matter, this gave rise to disputes over the adequacy of the substantial equivalence criterion itself. Is it not possible that compositionally similar foodstuffs might be nutritionally different; if so, the tests would – by definition – not pick up the difference (see Yearley 2005b: 160–162).

Exactly the same issue arises in relation to nanotechnologies. The key novelty about nanotechnology is that, when changes are made at the nanoscale, familiar substances can have novel properties. Toxico-pathologist Vyvyan Howard writes for example that the ultrafine fraction of aerosols:

> tends to be preferentially deposited in the alveolar portion of the lung, beyond the mucociliary escalator. In the alveolar region the alveolar macrophages, the final defence mechanism before particle internalization occurs, have difficulty recognizing the smallest particles and in addition they are easily overloaded by the numbers of particles arriving. Once internalized, insoluble particles appear to have the ability to translocate to other body compartments. (Howard and Ikah 2006: 163)

In other words, a regulation based on the chemical make-up of products is not likely to be sufficient for the regulation of nano-scale substances since the body's reaction depends not only on chemical composition but on particulate size. Here again, previous knowledge of the properties of the substances involved (whether carbon in so-called fullerenes or copper in copper-nanotubes and so on) is not necessarily a guide to how nano-versions of those elements or chemicals will behave in the environment or the human body. It is not sufficient to look at 'the facts' to arrive at a conclusion about adequate regulation of nanotechnology products since the test which generates 'the facts' itself depends on assumptions about similarities and differences between existing carbon products and the novel and as-yet-unregulated nano-carbon products (and so on).

And once again, the same issue arises in the case of synthetic biology where novel organisms that are unprecedented in evolutionary terms will need to be assessed before environmental release. The point is not that it is necessarily foolish or wrong to undertake such releases, rather that any decision about environmental release is neither wholly factual nor wholly a matter of 'ethics'. In the case of GMOs an attempt was made to make the decision look as much as possible like a factual matter, but critics were able to point to the putative interests behind that move. According to Millstone et al. (1999: 525), the 'biotechnology companies wanted government regulators to help persuade consumers that their products were safe, yet they also wanted the regulatory hurdles to be set as low as possible. Governments wanted an approach to the regulation of GM foods that could be agreed internationally, and that would not inhibit the development of their domestic biotechnology companies'.

For all three of these novel technologies (GMOs, nanotechnology and synthetic biology) the same overall problem arises. It is not possible to show definitively in advance that tests predicated on existing knowledge are adequate for a new technology of great but indeterminate novelty. Under these circumstances, an appeal to the facts simply will not suffice since judgements have to be made before the *tests that are supposed to determine the facts* can be undertaken.

The Limitations of 'Is' and 'Ought' in Relation to Synthetic Biology: Ought

On the other side of the same divide, where ethics is supposed to dominate, it is equally clear that prominent ethical questions are not resolved through ethical enquiry alone. For example, the Cho et al. paper on 'Ethical considerations in synthesizing a minimal genome' (1999) to which Venter makes frequent reference undertakes surprisingly little ethical analysis (see Yearley 2009: 561). It outlines many of the societal challenges surrounding the possible adoption of synthetic biology but does not arrive at ethical conclusions through ethical analysis (for a related sociological analysis of US bioethics see Evans 2002). Similarly the methodology of the European Union's Synbiosafe project is not to carry out ethical analysis per se but to conduct interviews with synthetic biology community members and ethical and safety experts.[3]

Rather than undertake explicit ethical analyses themselves, the authors of the Cho et al. paper observe that: 'Moving forward with caution requires that the scientific communities be in continual conversation with the entire [*sic*] society, working together to address key ethical and religious concerns' (1999: 2090). One can, of course, see that it is an appealing ambition to consider the needs and – maybe – the views of all sectors of society. But the idea of 'continual conversation' with the *entire society* is clearly impossible. It sounds reassuring and attractive, but is manifestly unrealistic. Moreover, in so far as it could be achieved, it would not be an ethical examination but much more of an empirical enquiry. It would be akin to a social scientific assessment of the facts of public views – an 'is' and not an 'ought'.

Conclusion: The Sociology of Engineering the Natural World

Sociologists and social commentators are rightly interested in synthetic biology. It is potentially an area of major innovation in scientific understanding, an area of conflict over intellectual property (Calvert 2008) and an area of potentially far-reaching environmental impacts (ETC Group 2007). But in its novelty and in the scientific community's willingness to promote ethical and societal reflection, it is also a key example of the way in which technical and ethical issues are framed in scientists' discourse.

In this chapter I have reviewed one prominent framing of science and ethics, of is- and ought-questions, and I have highlighted shortcomings within this framing. I suggest that one job that environmental sociologists and sociologists of science can do in interdisciplinary contexts, alongside studies of particular cases, is to engage with scientists' preferred divisions of regulatory and environmental issues into their 'factual' and 'ethical' components. Sociologists can challenge the kinds of monopoly that scientists claim over the 'factual' components (since they are seldom as exclusively factual as appears at first sight) and apply similar critical resources to the analysis of the ethical components. I hope that the case I have reviewed here indicates what can be learned from trying to unpick the making of 'is' and 'ought'.

[3]See the second sheet of the Synbiosafe overview at http://www.synbiosafe.eu/uploads///pdf/Synbiosafe.pdf

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Chapter 7
Social Simulation: A Method to Investigate Environmental Change from a Social Science Perspective

Andreas Ernst

Abstract This chapter discusses six challenges that are posed by the complexity and dynamics in the field of environmental behavior. These challenges are to explicitly represent (1) behavior as a process, (2) decision making, (3) social interaction, (4) interactions of humans with the bio-geo-physical world, (5) space-related interactions, and (6) to connect to the natural sciences, e.g., to climate models. Social simulation is proposed as a method being able to meet all of these challenges. By modeling individual decisions and their interactions as the basis of behavior, macro phenomena at the society level emerge. The method generates observable behavior at runtime, which can be scrutinized and compared to empirical data. It is presented how social simulation deals with each of the challenges, together with corresponding examples. A critical discussion concludes the chapter and relates to the fundamental advantages, but also to the practical costs of simulation.

Keywords Social simulation • Modeling • Social science methodology • Social interaction • Decision making

Six Challenges for the Environmental Social Sciences

Environmental behavior, using environmental resources and causing environmental change or adapting to it, is a complex issue. The natural environment itself can be considered as a complex system: it possesses a high number of variables that are highly interconnected. This results in a structure that is non-transparent to us, and that produces dynamic behavior. There are numerous heterogeneous actors that are interconnected through strong social interactions that are embedded in multiple levels

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of institutional and cultural layers which act as normative guideline to individuals. Moreover, environmental behavior often has a strong spatial relation that manifests itself on multiple, i.e. local, regional, and global scales. No wonder that this raises some challenges for the scientific investigation of environmental change from a social science perspective. In this chapter, the method of social simulation is proposed to deal with issues arising from the complexity addressed above.

There are six challenges for the environmental social sciences that are discussed here: (a) Explicitly consider behavior as a process, (b) explicitly represent decision making, (c) explicitly represent social interaction, (d) explicitly represent the interactions with the bio-geo-physical world, (e) explicitly consider space-related interactions, and (f) be able to connect to natural science models. These challenges will be discussed in turn below.

(a) *Explicitly consider behavior as a process*: Interaction between humans and the environment is neither static nor is it bound to ever come to some equilibrium. It is a process with a temporal sequence, where activities of varying temporal extension and latencies of feedbacks play a role. Decisions are taken on the basis of experiences from the past and with regard to incentives in the future. They are embedded in a stream of individual interactions with the social and the bio-physical environment. The conditions of behavior change with every point in time, and often just as a consequence of behavior itself. Static theories can merely give snapshots, but hardly provide insights in the processes that steer the phenomena being observed.
(b) *Explicitly represent decision making*: Behavior is an outcome of individual perception, goals, behavioral habits, reflection, learning, social interaction, interaction with the bio-geo-physical environment, and so forth. Taking into account the internal workings of decision making gives a semantic flexibility to reconstruct and investigate behavioral processes, but also makes them transparent by explaining why things happen.
(c) *Explicitly represent social interaction*: Obviously, environmental behavior is profoundly embedded in social interaction – for better or for worse. Successful collective actions are seen alongside with social "lock-ins," where society prevents environmentally appropriate innovation and action. Norms, collective attitudes, but also behavioral innovations and change are both mediated by social networks, social institutions, or media. Non-linear social phenomena like avalanche-like shifts in public opinion may result from the social interaction of a high number of individuals. Thus, in order to explain societal phenomena, the micro-perspective of social interacting individuals may be a very fruitful way to look at things.
(d) *Explicitly represent the interactions with the bio-geo-physical world*: In the domain of environmental behavior, strong interactions of human actions with the bio-geo-physical, i.e. non-social world are decisive. In the environmental social sciences, environmental sociology, environmental psychology, or environmental economics, this interaction should be constitutive for the discipline. This interaction also brings into focus the temporal interdependence of human actions and their consequences in the bio-physical world, where the latter are

often considerably delayed and thus make it harder to install appropriate feedback mechanisms.

(e) *Explicitly take into account space-related interactions*: A very special aspect of the environmental social sciences is its intrinsic relation to space. At the same time, one can state that very often in the classical domains of social science, the influence of geographic or architectural settings is being completely ignored. It usually is supposed that these factors would play but a minor role in describing and explaining human behavior. Often however, space does matter. Natural resources are not equally distributed. For example, urban citizens behave differently from a rural population, and inhabitants of coastal regions may have very different concerns than mountaineers.

(f) *Be able to connect to natural science models*: There is a pragmatic aspect to the argument proposed here as well. While it is inevitable to take notice of the recent developments in climate change modeling for the environmental social science research, it is also true that the natural science global change community would like to take into account results from the social sciences regarding human drivers, and adaptation to climate change impacts. Answers from the social sciences to the burning questions of global change are not missing. But they are phrased in a methodical language that is largely incompatible with the models stemming from meteorology, hydrology, agro-sciences, etc. It may be the case that some researchers are sympathetic with that incompatibility, which may stem from a more principled humanities-oriented understanding of science, or simply from conservatism. To the author however, the fruitfulness, if not the need, of a closer cooperation of the natural and the social sciences to help solve the current problems of the man-environment system is more than obvious.

Given this set of considerable challenges, one finds that the classic social-sciences set of methods of theory building does not lend itself very easily to deal with them. Even simpler behavioral ideas or theories show such a complexity that classical theory building is prone to fail. Experimental-statistical, analytical-mathematical or even a mere verbal treatment of the phenomena is hardly sufficient to capture the individual and social processes and interactions over time. One can suspect that often enough, the applicability of some widely known or accepted method alone serves as a guiding line for choosing an approach to a research question. Consequently, phenomena get linearized, homogenized, de-dynamized, and de-spatialized. So, basically, the above challenges still exist. How do ways look to cope with them in a fruitful manner?

Responding to the Challenges: Social Simulation as a Method

The challenges pointed out above have not only been formulated with the method of social simulation in mind, but they also constitute fundamental methodological problems of the environmental social sciences per se. Social simulation – i.e. the computer simulation of social phenomena of any kind – uses modern computer technology to answer these challenges and meanwhile can be considered as an established method.

A constitutive common element of this method is the explicit representation of the decision makers (the actors, or the agents in computer science language). Agents in a broader sense are autonomously acting pieces of software. In a more specific sense, especially in the social sciences research, they are interpreted as a description for human or institutional decision makers (Gilbert and Troitzsch 2005). Acting entities can be heterogeneous models of individuals, households, political decision makers, industries, NGOs, tourists, states, etc. They can be as differentiated, and as heterogeneous as one likes and/or the underlying empirical data permit.

The focus thus explicitly is not on some societal macro phenomenon to be generated, but on the individual bases of this phenomenon. A common finding is that overall behavior with the characteristics and the complexity one observes empirically emerges from the interaction of individuals with each other and with a (changing) world. The significance of this explicit interaction with the environment for the environmental social sciences is not to be underestimated. To realize this, we have to resort to on some assumptions about behavior and decision making, if not cognitive processes. Correspondingly, agents possess simulated perception processes, a memory for observed, local knowledge, perhaps learning processes of different complexity, varying skills, capacities of problem solving, initiative and degrees of freedom to act. Depending on the goal of the model, these building blocks can be combined and their degree of detail can be tailored to the task. The blocks can also be used within a model to generate varying agent types that together produce a heterogeneous simulated population.

Social simulation yields – and in this respect it is very different from most other methods used in the social sciences – observable behavior at runtime. These behavioral results can be analyzed and scrutinized in detail like any other empirical data, or shown and explained to stakeholders. Social simulation makes theories "live". Therefore, especially in the environmental social sciences they are regarded as an apt, elegant and modern process description for human and institutional deciders (Gilbert 2008). Moreover, and this argument will be somewhat recurrent in the following paragraphs, it can serve as an integrative tool: social simulation can be used for unifying the representation of actors on various levels, and it connects environmental social science to bio-geo-physical representations of the world.

In the last years, there have been numerous successful applications of social simulation to scientific and societal problems: in policy making, energy, land and water use, mobility, conflict and conflict resolution, social dilemmas, and others (to name but a few readers: Edmonds et al. 2008; Gilbert and Troitzsch 2005; Gotts et al. 2003; Takahashi et al. 2007; and the contributions to the Journal of Artificial Societies and Social Simulation, JASSS). A systematic overview of empirically based social simulation is given by Janssen and Ostrom (2006).

This chapter will be oriented along the six challenges sketched above, and specific examples will be given along with each of it, mostly stemming from own research, to illustrate the point and the role of social simulation in dealing with the challenges.

Modeling Behavior as a Process

It is most interesting to investigate why some variable in our world, such as population size, political opinion, or stock trade volumes develop over time the way we can observe them to develop. For a suitable explanation of the phenomenon, we have to provide an account on how the ongoing interactive process, the stream of behavior and feedback with the world, functions. It is a first step, but not enough, to empirically isolate the triggers and consequences of behavior. Only enhancing these mere snapshots with assumptions about the inner workings of decision making (see below) lets us reconstruct a stream of behavior that is not per se bound to fall into equilibrium or some other stable state.

The following example shows the empirically based, simulated relative changes in land use strategies from year to year of farmers in the Odra region in Poland under specific societal and weather conditions (Elbers and Ernst 2008). Nor will this simulated time series come to a stable state, nor it is expected to do so in reality. The fine-grained temporal resolution of the data stream gives the opportunity to provide important hints to the causes and preconditions of e.g., extreme events in the observed time series, or of highly dynamic phases vs. calmer phases.

Inform About Decision Making

Agent-based models include – to a more or less elaborate extent – the individual decision makers' goals, their perception of the social and/or geo-bio-physical environment, their rules of behavior, and the like. So, looking at the trace, i.e. the history of the chain of simulated decision making, we are informed about the way the simulated perceiving and thinking took. The following are two rules of the model underlying the time series in Fig. 7.1, formulated in natural language:

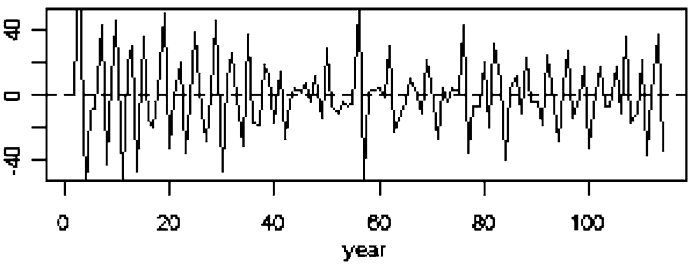

Fig. 7.1 An example of a behavioral stream: simulated relative changes in land use strategies of Polish farmers in the Odra region (Source: own work)

IF a farmer is maintaining his drainage ditches
    AND he nevertheless has a very low economic success
THEN he stops maintaining the ditches.
IF a farmer is not maintaining his drainage ditches
    AND many other farmers maintain their ditches
THEN he starts maintaining the ditches.

While the first rule defines the impact of economic success on behavior through formulating the respective behavior change, the second one specifies the impact of social information from the acquaintance or colleague network of the decision maker. Heterogeneity may be introduced by providing agents with different rules.

Figure 7.2 shows the development of a simulated decision maker's satisfaction with the outcome of four different behavioral options while playing an environmental game (Ernst 2003). It thus shows the result of the (simulated) player's interaction with its (also simulated) social and ecological environment. The highest rated strategy at each time step is the one that is chosen by the player. While two options (the over-harvesting and the relative gain strategies) are rated very low from the beginning, the two other strategies dominate the course of action for a long time. Learning events, caused by thinking through the success of all four strategies in comparison, however, lead to a strong discounting of these strategies. We can suspect that, if the game lasted longer, one of the so far low rated strategies may take over the action. While this cannot be derived from the overt, observable behavior, we know by looking at that graph that learning quietly has taken place that may well be the cause for an abrupt change of behavior to be expected. Explaining why things have happened or are about to happen is an especially nice feature of using the simulation method in applied contexts.

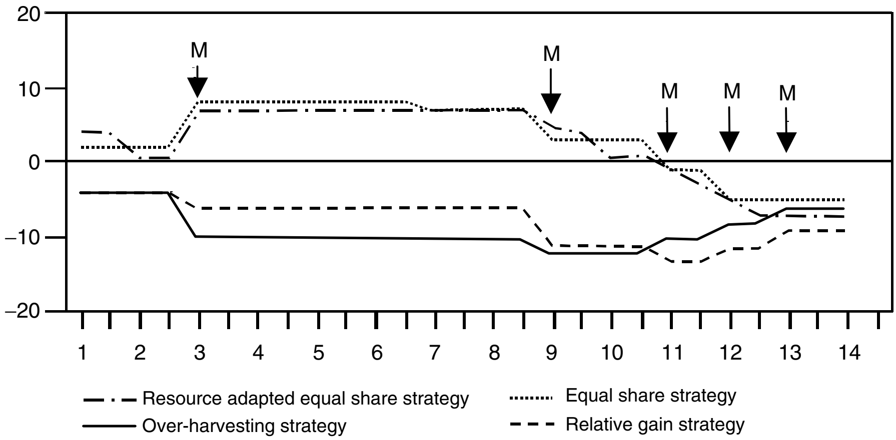

Fig. 7.2 Development of a simulated decision maker's satisfaction with the outcome of four different behavioral options while playing an environmental game over 14 rounds (Source: own work). Positive numbers denote a positive rating of a strategy, negative numbers a negative rating. M: Learning events. Further explanations are in the text

The Processes of Social Interaction Made Explicit

Innovative behavior often spreads through social networks, by word of mouth, formal information, or by simply watching others' behavior. Figure 7.3 shows the (empirically based) acquaintance and kinship network of farmers in a Polish village that also underlies the results presented in Fig. 7.1. One can easily distinguish more "central" actors and more isolated ones. This gives some predictive power to where (and also in which sequence) socially induced behavioral shifts will take place.

We know that such social networks often provide a source of social stability. If however, key persons in the networks (the so called hubs, connected to many other nodes) change their behavior in some respects, this may lead to a behavior

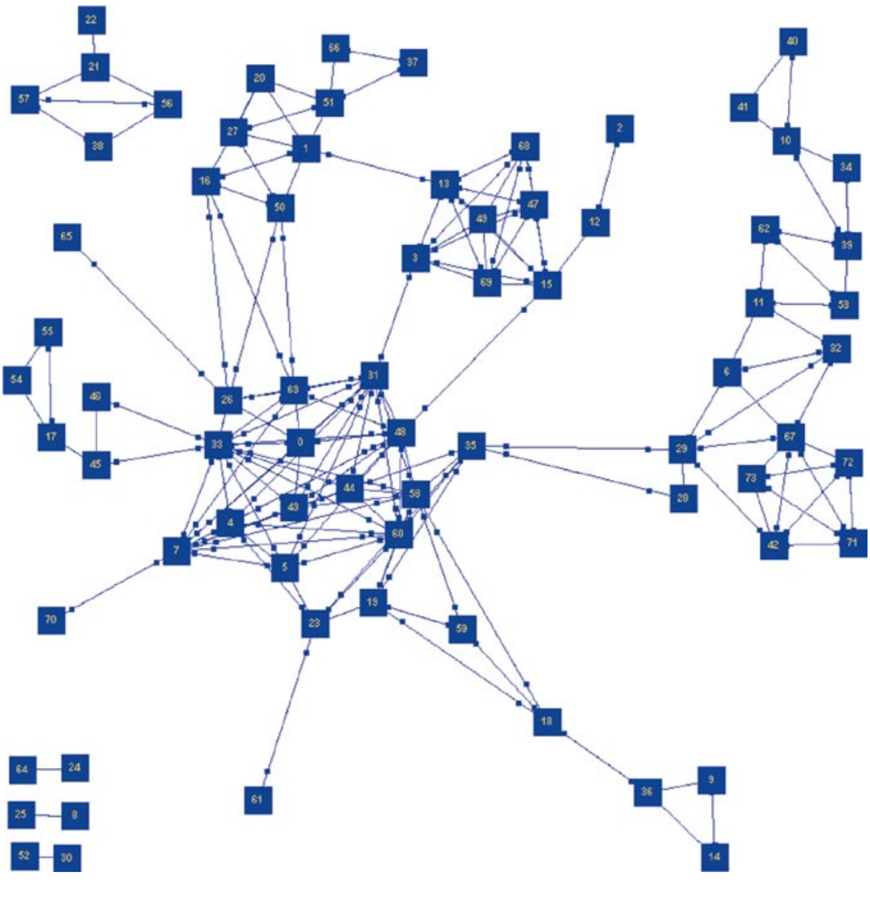

Fig. 7.3 Graphical representation of an empirically derived social network (Source: own work). The nodes of the network denote its members, in this case Polish farmers in a village, and the links represent acquaintance or kinship relations

spreading rapidly. From an aggregated, outside view, this often takes the form of an accelerated, avalanche-like process of societal behavioral shift. Looking more closely, this can be attributed to the consequences of changing majorities within the specific structure of the social neighborhood of the individual actors.

Let the Actors Interact with the World

Adding to the social dimension, social simulation can include feedback loops through a direct connection to a modeled geo-physical environment. These loops are hard to grasp with the classic social science set of methods. Successful applications of social simulation include models of land use and land use change, energy and water use, diffusion of technologies, conflicts and conflict resolution, resource dilemmas, mobility, among others. A meanwhile classic of this approach is the *Sugarscape* model of Epstein and Axtell (1996). On an artificial world shaped like a bagel (a so-called torus, resulting from connecting of the opposite sides of a checker-board-like grid) are growing resources, "sugar" and "spice". Simulated agents consume these resources, the amount depending on their metabolism. The model investigates the development of this simple artificial society by introducing new rules of behavior and attributes of the agents step by step: movement, perception, death and reproduction, private property, culture, trade, epidemics, violent conflict, and others. Macro phenomena emerge, like e.g. the unequal distribution of wealth over the artificial population, that are interpreted in macroeconomic terms. More examples of interaction with the bio-geo-physical world will be given in the following sections.

Moving and Acting in Space

Social simulation lends itself to being connected to spatial representations. The artificial agents can easily be located on a grid representing space, as they interact and move. E.g., the *Crowds* model of Jager et al. (2001) combines a psychological theory of avoidance or raising quarrel (e.g., by hooligans in front of a football stadium) with a spatially explicit simulation. The simulation informs about the effect of various proportions of hard-core hooligans and bystanders on the prevalence of violence.

Often, the spatial attributes of a simulation refer to a geographically specific area. So does the *Anasazi* model (Gumerman et al. 2003). The authors try to gain insight into a historical phenomenon by testing hypotheses why a native Indian tribe gave up an area where they had been living for centuries. The model includes geographically located agents in the representation of an actual natural terrain, and uses extensive archeological data.

International conflict and uprisings are the target of the *GeoSim* model of Cederman (2002). It simulates geo-political conflicts on the basis of the interaction of basic policy strategies, neighborhoods, and geographical constraints. The results show e.g., that mountainous areas are more likely to be the point of origin of uprisings, mostly due to the relative distance to the capital and state resources.

Connect to Natural Science Models? Connect to Natural Science Models!

One of the strongest points of social simulation is put into effect when it is coupled with models that represent bio-physical aspects of the world. This is especially true for the environmental social science applications. The *DANUBIA* model (Barthel et al. 2008; Ernst et al. 2008) is one of them. Its goal is to represent the human and natural processes related to the water cycle in the upper Danube basin in southern Germany and parts of Austria. This area extends over about 72,000 km^2, with strong gradients relating to its geographical characteristics and land use. The system encompasses 11 disciplines with 16 models (from hydrology, remote sensing, water management, meteorology, economy, agricultural economy, ecosystem research, glaciology, tourism research, and environmental psychology). The models have been coupled at runtime, i.e. they exchange their data while they are running, so as to realize a continuous feedback between them. This framework has been provided by computer scientists.

The interdisciplinary integration in the model is based on a number of concepts that answer ubiquitous problems of connecting disciplines, not only when modeling:

1. At the beginning of the process, the interfaces between the disciplinary models have been defined. The domain to be represented in the overall model was partitioned so that no phenomenon was treated in two different parts in the model, and no variable was computed in two places. Rather, a model needing some information that is computed in another has to fetch the data, process them, and pass the results to any model doing further processing on them. The attributes of the information passed on (time step, grain size, metric, etc.) are part of the interface description. This clear definition of interfaces not only helps with keeping the model structure clear, but can also be regarded as a hint on how to proceed with interdisciplinarity.
2. Encapsulation is a notion from computer science that denotes that the inner workings of a system part do not have to be known to the other parts. Every model being part of *DANUBIA* is responsible for the empirically appropriate representation and computation of its outputs. The receiving models have to trust the appropriateness of the data provided. This makes sense since the models are being built by the respective domain experts.
3. As can be seen from Fig. 7.4, the models of the *DANUBIA* system are grouped into components according to five themes: atmosphere, land surface, river network, groundwater, and actors. Within and between these objects, communication is routed through the data interfaces described above. There are synergies of the

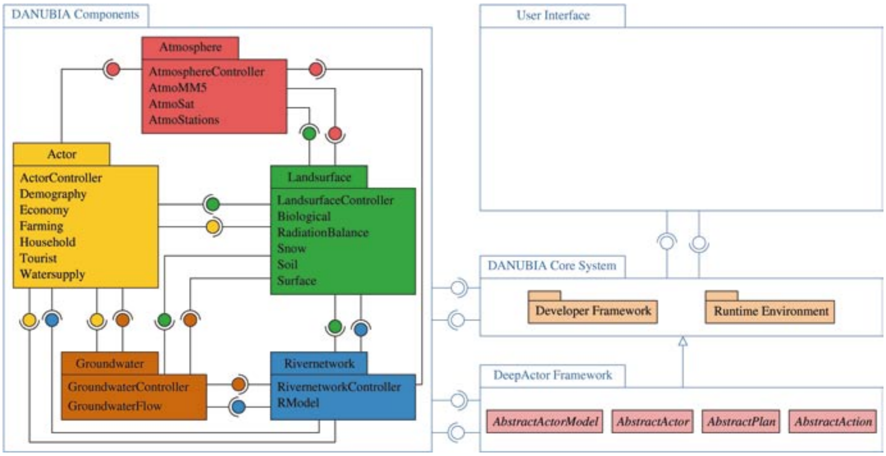

Fig. 7.4 The integrative structure of the *DANUBIA* model. The five components with their disciplinary models are shown as well as the interfaces to exchange data between them

grouping. For example, in the actor component, all actor models have the same basic structure of a modeled agent. Just some parts of the decision architecture and of course the rules and the data differ.

4. All the data exchanges happen relative to a common spatial frame. In the system described here, this frame was decided to be one square kilometer. This is obviously a compromise for any discipline, since some of them work on (much) smaller scales (like ecology), and others on much larger ones (like meteorology). However, it is obviously essential that the in- and outputs of the coupled models can be perfectly matched. For the social sciences however, this poses a tricky problem: social data of any kind almost never are collected relative to square grids, but to administrative or social boundaries. GIS-based intelligent mapping mechanisms can be used to translate, e.g., communal populations to households on a km^2 raster.
5. All participating disciplinary models of *DANUBIA* are process models in the sense discussed above. To fully integrate these models, a common temporal metric has to be defined. Some models have a quicker computational time step than others, due to their domain. The crop and forest growth, on one hand, has to be computed every hour to reflect the effect of sunshine and clouds on plant growth. Models describing societal processes, on the other hand, may have a time step of 1 month. A mechanism has to synchronize all model computations and assure that the outputs of one time step are complete before the next time step can be started.
6. While there has certainly been much progress in the natural science earth system modeling to inform about the likely global changes, the results of highest interest to policy makers have to come from social simulation. How will society react to the changes? In *DANUBIA*, a common social simulation architecture is the basis of the models for the farmers, the water supply companies, the water-using

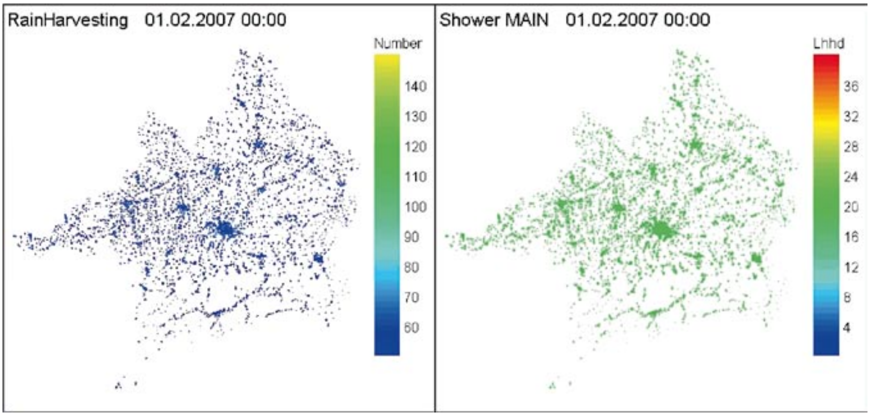

Fig. 7.5 A map of the number of rain harvesting systems in the Upper Danube river basin (*left*) and of liters of drinking water used per day and household for taking showers (*right*) for a specific simulation time step as examples of outputs as modeled by the household model in *DANUBIA*. One can distinguish the only sparsely populated region of the Alps with the Inn river valley in the South of the basin, and the larger cities further north, e.g., Munich in the middle (Source: own work)

households, the tourist infrastructure, and industry. Figure 7.5 shows results stemming from the household model (cf. Ernst et al. 2008).

As has been shown by the *DANUBIA* example, coupling social simulation as "running social theories" can provide insights that are hard to produce otherwise due to the manifold feedbacks between social and natural systems when dealing with environmental questions.

Scenarios: A Glance into the Future

The popularity and power of the natural science models like the global climate models do not stem so much from them describing past reality but from being able to extrapolate existing data in an intelligent and process oriented manner into the future. Social simulation does provide the means for doing the same for the investigation of social issues. Of course, some social phenomena may be more volatile than natural science ones, and of a chaotic nature and thus be generally unpredictable. However, it is worth to explore possible futures and possible paths leading to these futures to get a feeling of what possibly to expect and, in the best case, on how to steer. Social simulation produces continuous output and is thus capable of scenario building. By including assumptions about future drivers or policy interventions, they give an explicit account of the resulting consequences and dynamics, and can serve as a test bed to shed light on a number of questions concerning mitigation and adaptation to global environmental change.

Scenarios may stem from storylines developed by a panel of stakeholders and experts, and then upgraded with computer simulations. Alcamo (2001) describes the "storyline and simulation" (SAS) approach which connects qualitative and quantitative elements of scenario building in a coherent feedback loop. The results of scenario runs can be aggregated to indicators of success and failure, but inspecting the underlying time series data will provide additional insight in the reasons for the observed developments.

Discussion

This chapter has highlighted the potential of social simulation for the environmental social science investigation of global change. Social simulation lends itself to spanning and tightly connecting levels of abstraction, geographic extent, and different disciplines, which is obviously an important aspect in environmental research.

It has been shown that the method provides the means to deal with the process characteristics of behavior by endogenizing them. Decision making processes are thus being made explicit to the degree one deems necessary to provide enough depth of explanation. Overt behavior of a simulated agent can be demonstrated live and justified by inspecting the otherwise covert, hidden decision making processes. Interaction with a simulated bio-geo-physical environment can be an integral part of the system – which gives a handle on the problem of otherwise tricky feedback loops between the social and natural spheres. Simulated agents can be made to act and move in space, so as to take into account physical constraints and incentives of behavior. Last but not least, social simulation models can be used to generate scenario information to evaluate and compare outcomes of possible futures.

Any kind of simulation as a method of theory and model building is rigorously formalized. It thus can be communicated as a whole to the scientific community for scrutiny. Models may simplify reality indeed, and sometimes drastically so. On the other hand, they are pitiless in pointing out their own weaknesses (stemming from the underlying theory or from the implementation of the model) and help work on them in a fruitful way. An empirical validation of a model will in most cases not only encompass the observable behavioral output but also the underlying elements and core processes. This makes social simulation a very rigorous method of theory testing. Once the underlying processes have been cross checked to satisfaction, the model can be used as a test bed for interventions on a simulated population, like policies, information, payments and so forth.

Societal processes are characterized by non-linearity, surprises, and basic unpredictability. Scenarios stemming from social simulation thus do not have to be confounded with predictions. They rather explicate the development of things under a fixed set of boundary conditions, which abstracts from anything happening in the future we are unable to know. However, scenarios can be very helpful in clarifying the role of characteristics and processes that social scientists consider important for adapting to global environmental change: questions of societal resilience against environmental shocks (e.g., Berkes et al. 2003), the role of social cohesion in networks and other indicators of social capital (e.g., Ernst et al. 2007), the diffusion of environmental innovations, and integrating representations of lifestyles as heterogeneous characteristics of society (e.g., Schwarz and Ernst 2009) to explain environmentally relevant behavior, among others.

Why social simulation has not yet spread to every corner of the scientific world? There are some drawbacks to be considered, as matters stand. The drawbacks are mostly of a pragmatic nature. The first is the obvious need of technical skills to produce a simulation. While the systems offered to support the model building process have made enormous progress in the last decennia and are now much easier to learn and to handle, programming expertise still is necessary for serious scientific work. Here – and this has to be stated with emphasis – we can observe a clear difference between the methodological training of most social scientists and the one of natural scientists. While it is unthinkable that, say, a meteorologist or a hydrologist leaves university without profound programming knowledge, this remains a marginal phenomenon in the social sciences up to now.

A second drawback may be for some scientists the pronounced need of (time series) data to build, calibrate, and validate social simulation models. On the other hand, once running, the simulation can inform like no other method about the workings of the process theory "in action", which may well compensate the effort of gathering the corresponding data and building the model.

A last consideration may be given to the best way of publishing results from a social simulation. It is hard to describe a theory, the empirical data, a model, and the resulting simulation data, and discuss it all in one article. The situation worsens if one faces a public not aware or not used to social simulation work. Journals that routinely present simulation work ask authors to hand in the code to be published on the publishing house's web site, or at least to publish it on some other web site. This, together with a culture of describing the program on a middle level of abstraction in the article, not only gives everybody interested the opportunity to try out the model and replicate its results. It is also the basis for a continuous comparison and development of models, and for a convergence of theories, as far as one can judge now.

All things considered, social simulation represents a step forward in both the epistemological and pragmatic regards, i.e. in assuring the connectivity between the social and the natural sciences. It fosters interdisciplinary scientific communication and cooperation and provides means to present scientific theory to the public by making them "live" in the computer. Both properties are highly needed for the scientific investigation of environmental change.

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Chapter 8
Trust and Cooperation as Requirements for Maintaining Environmental Governance Capacity

Stefan Walter

Abstract Trust can be understood as a mechanism to reduce social complexity. Trust is located in the relations between people, making it a property of social systems. Trust is a prerequisite for the functioning of society, providing a foundation upon which sustainable development, environmental justice, etc. are only possible. Consequently, there is a great interest to maintain or strengthen trust in systems and institutions, e.g., in money as an exchange medium. The requirement of trust for environmental governance sets the boundaries for social change and reduces the probability of implementing measures that might undermine trust and social cohesion, e.g., environmental policies that threaten investments in the economy. Contemporary socio-economic trends, including the acceleration of market processes, globalization, and the consequential growing complexity in society make it more difficult to maintain trust. Thus, it is questioned whether efforts that potentially improve the society-environment relationship are actually desirable in society.

Keywords Trust • Cooperation • Environmental governance • Social systems • Social change

Introduction

The study of cohesion and cooperation is philosophy's field of investigation *par excellence*. The human interest in the collective is perhaps as old as philosophy itself and the relationship between the human collective and its environment represents one of the most important elements in the endeavor into human ecological theory. One stream of thought is concentrating on the meaning of cooperation for

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providing the necessities for life, be they physical or mental, and culminating into the conclusion that without cooperation, we would not exist (Stewart 2000). Another stream of thought focuses on the study of community as offering insights into its limits of modifiability. Finding out about the boundaries of possible change is vital in understanding strategies for changing social structures for the greater good of society, for "man is interested in its [the community's] nature because he usually wishes to change it" (Urban 1919: 547).

What becomes additionally significant in the analysis of change of social structures is the probability element. We have to ask what change is realistic; also, what change is desired by society. Reflecting on these questions is particularly relevant when thinking about potential feedback effects that collective activities – addressing a problem – can have. Consider the case in which society wishes to deal with adverse ecological impacts it produces. The intensity of ecological impacts today could be considered due to a general acceleration in society, which has affected the speed of exploitation from society's environment (cf. Walter 2008). A control of this exploitation requires society; in turn, society causes the exploitation. Is this an irresolvable conflict?

In this context it is interesting to consider a major theoretical approach in the sociology of human-environmental relations, which is concentrating on solving ecological problems through modernization of industries and infrastructure. The foundation for this approach lies in ecological modernization theory, which has gained high prominence since the beginning of the 1980s and is now part of many environmental policies and state strategies across Europe (Murphy 2000). Hence, it is a leading theory as it enjoys broad support among political and economic elites. Understanding why ecological modernization theory has been so successful will be one aim of this article.

Looking at the environmental governance issue from the perspective of human ecology, which focuses on the build up and maintenance of cohesive regimes against an environmental background, I like to demonstrate the possible conflict between societal interests and environment through the introduction of the concept of trust into this discussion. Trust, as a resource, is of fundamental importance for the production and maintenance of society. Trust is, so to speak, the lubricant of cooperation and without it collective action or agency as a carrier of collective action would not have the foundation to exist (e.g., Jalava 2003). Therefore, I will inform about how trust is produced and maintained in society and how trust contributes to collective action. The latter will be shown through highlighting the relationship between trust, power and control. By means of the economy as a collective entity I want to point out how the maintenance of that social system yields the power that politics requires to establish binding decisions on a societal level. Showing these interrelationships between economy and politics will give important insights into the nature of political control and is most interesting to understand the probability element in environmental governance that aims to provide the basis for resolving society's ecological impacts.

The discourse on globalization has highlighted many evolving elements of society and social life, ranging from increasing global trade to global strategies in managing ecological issues. In an abstract sense this can be summarized in the concept of increasing complexity of society. In such conditions the trust element in maintaining society will receive heightened importance (e.g., Misztal 2001; Bijlsma-Frankema and Costa 2005). The questions concerning the degree of change and desirability of change in society are addressed here. Thus, under increasing complexity it is very relevant to consider whether it is probable that any serious measures concerning ecological sustainability are realized. In the light of maintaining future governance capacity it is also highly relevant to ask if any radical changes that environmental policies could bring are actually desirable in society.

Hence, the article will also shed some light on the feasibility of ecological modernization concerning the improvement of the environment-society relationship. Incorporating a complexity element into the feasibility analysis might yield contrary information when considering that modernization through innovation might lead to dependency-increasing technology regimes and uncertainty of outcomes (e.g., Leydesdorff 2000). Consequentially, is there a contradiction or is there a solution inherent to environmental policies?

Some Theory of Cooperation

Reasons for Cooperation

A major stream of philosophical thought concerning the community is concentrating on the assumption that without cooperation humans could not exist. Pretty much everything that we consume – be it goods, services, or intellectual material – is the product of cooperation. Hence, our physical and mental survival – i.e. our sustainability – is dependent on others. Cooperation is, for example, achieved through the division of labor, which is essentially a functional division. People specialize in certain trades so that they do not have to perform just any economic activity (Stewart 2000). Through this general specialization, people are also motivated to cooperate. Functional specialization creates a network of dependencies, which can very well be considered an evolutionary mechanism to promote cooperation between humans.

Divisions or functional differentiations in society have significant evolutionary advantages. Cooperatives can adapt to much more complex conditions (Stewart 2000). Differentiations in society are adaptations to environmental complexity as much as they are adaptations to complex conditions in society. Adaptations are necessary to ensure a continued survival of the cooperative regime (Luhmann 1984). Of course, cooperation also enables humans to influence their environment on a much larger spatial and temporal scale. Although in the context of managing ecological impacts, this is not to be necessarily regarded as a positive element. It rather gives insight to the characteristic of society that has to be addressed when dealing with society's relationship to its environment.

Socio-cultural evolution is characterized by continuous improvements in cooperation between humans and it produces mechanisms that incorporate self-interested individuals into cooperative regimes so as to reduce conflict (Stewart 2000). An interesting comment by Wuketits (1993) states that biological constraints that humans are subjected to, can inform about the possibilities for human social organization. Given that morality and values are not part of biological evolution, biological constraints are also constraints for the values guiding cooperation: morality is relying on evolution. One might speculate whether evolution generates a morality that aims at increasing cooperation.

Niklas Luhmann considers the role of society to transform the improbability of survival of the individual into a higher probability of the maintenance of a certain social order. Thus, the probability of sustaining a cooperative regime is higher than the probability of survival of an isolated human (Luhmann 1997). Evolution is adaptation to evolving complexity, within the system (internal) and environmental (external). In Luhmann's viewpoint cooperation is a response to life's complexity where specific cooperative regimes or mechanisms evolve to manage complexity.

Limits of Change

Cooperation does not evolve easily: Luhmann (1984) writes that social structure, or, more advanced, functional differentiation is evolutionary improbable. Barriers to cooperation appear to exist for all reproductive organizations, thus also for social systems. Self-interest is the most significant barrier to cooperation in society. The consequence of the improbability of cooperation is that cooperation becomes highly important (Stewart 2000). This seems somewhat paradox, but it essentially means that cooperation is in the center of efforts to maintain cooperation, e.g., of policy.

Basic mechanisms to support cooperation include kin-selection and reciprocal altruism, which are, however, ineffective for cooperation over wide spatial and temporal scales. Therefore, a mechanism is needed that permits trusting in complex, uncertain situations. Generalized media of communication represent such a mechanism that have been evolutionary successful because they are capable of providing trust in a complex world, over wide spatial and temporal scales. These generalized media, such as money, have their function in permitting cooperation among people who might not know each other; precisely this is the case in modern society with its global trade links. All one requires is trust in the media; trust that they fulfill their function in supporting cooperation (Luhmann 2000 [1968]).

Given the limits of change in society, any policy dealing with ecological impacts – any environmental governance effort – must keep in mind the mechanism that supports cooperation, i.e. the generalized media of communication. Modifying social order cannot mean to dismantle elements (systems) of society. Precisely this would be the case if the policy objective would be to take apart the communication media that make humans cooperate – connect and interact – in the first place (e.g., Luhmann 1986). Any more radical change is not out of sight, however it must be remembered that a break-down of society's connecting mechanism would leave individual humans behind who are used to cooperation. They have adjusted to it, for instance through occupational choice. A radical change would, thus, leave many possibilities unrealized – a matter most likely unacceptable for society.

Moreover, while evolution has brought about great improvements concerning cooperation mechanisms, trust itself cannot be replaced. Trust is, as I have pointed out already in the introduction, of fundamental importance for the community and social order. Whether in person-to-person relations or society-wide cooperation, trust is the basic connector.

Trust and Cooperation

The Function of Trust in Society

Trust can be understood to be a mechanism that serves the reduction of social complexity (Luhmann 2000 [1968]). Complexity is a condition of systems; systems built up complexity in the course of evolution. Trust is located in the relations between people; it is not a psychological state of isolated individuals. Thus, trust must be seen as a property of collective units – of systems. Trust can be viewed as a prerequisite for the proper functioning of society (Lewis and Weigert 1985). The alternative to trust in social relations would be chaos. And no one trusts chaos (Luhmann 2000 [1968]: 47).

It is the function of the mentioned symbolically generalized media of communication to motivate the continuity of social systems. In relation to the success of the motivation to reproduce the system it is possible that the medium is used too much or too little. With respect to the economic system this can be easily illustrated by referring to the terms inflation (too much usage) and deflation (too little usage). The cause of this problem is a lack of trust in relation to the possibility of continuing the circulation of money. Inflation occurs when continued investments require more trust than the medium can produce. In this case the money becomes devaluated (expressed as a price increase). In turn, deflation occurs when the communication leaves opportunities to produce trust untouched. In that case money is circulated less – the future opportunities for using money as medium for payments decrease. The edge of either inflation or deflation is reached when the conditions for the continuity of the system becomes so strict that they do not permit further "reproduction" of the system's activities. These conditions are called hyperinflation and hyper-deflation, respectively. They reflect the situation before symbolically generalized media of communication had emerged and they illustrate the improbability of successful cooperation. The difference between now and then is that modern society is structurally not prepared to deal with the case of the improbability of cooperation. This can have serious repercussions into the trust of other systems, for instance the political (Luhmann 1997). The hyperinflation in Russia during the 1990's is a good example, which led to a strong fragmentation of the currency regime. However, a regime based on alternative means of exchange – barter – does not provide a common basis for governance, rendering politics ineffective (Walter 2009).

Thus, in conditions where trust is eroding, there is a serious threat that society could disintegrate. There is, therefore, a risk involved – a risk generated by the existence of trust, which would not exist if there was a functional alternative to trust. But without this trust that works as a foundation for society social relations, planning, justice, etc. are not possible. Planning is only achievable when the planner does not have to take into account all possible contingent futures (Lewis and Weigert 1985). The opposite would entail dealing with an infinite complexity, which is something that a system attempts to reduce. An erosion of trust or distrust might occur, but eventually society is not conceivable without a fundamental trust basis (Lewis and Weigert 1985). Consequently, society has an interest in maintaining or strengthening trust in social systems and its cooperation-enabling symbolic media.

Trust and Control

Control is based on several premises. Control has a need for codification, which means that rules and expectations can be merged into a common code (Bijlsma-Frankema and Costa 2005). In systemic thinking, social systems differentiate themselves from their respective environment through an individual logic based on a code; the code, in turn, is the way the systems control environmental stimuli. It is this common code, communicated through the symbolically generalized media, which provides the needed cohesion to achieve control. The common expectations that this communication yields forms at the same time a source for trust.

Furthermore, control requires the ability to monitor. Monitoring is needed to identify whether rules have been breached (Bijlsma-Frankema and Costa 2005). Systems observe and thereby apply their logic of distinction, for example distinguishing between solvency and insolvency or between power and opposition. This is known as a first-order observation. Additionally, a system is also capable of observing the way other systems and their ways of distinction operate. This is called a second-order observation. First and second order observations are continuously carried out since observing and distinguishing is the requirement for the system's continued existence (Gershon 2005).

Moreover, effective control requires a way of enforcing rules and to sanction deviant behavior so that a realistic threat can be made. Social systems theory acknowledges the existence of the possibilities to sanction behavior in trust relationships (e.g., Luhmann 2000 [1968]: 38–47). Negative sanctioning has been sometimes seen as being in conflict with the very nature of systems theory (e.g., Borch 2005). A social system is in control and observing; consequentially its environment cannot simply exercise control of the behavior of that system.

Hence, sanctioning does not seem to be permitted. Luhmann, for example, has conceptualized power in a functional way, within the political system of society, as a symbolically generalized medium of communication. Just like the economy circulates trust-enabling money, the political system circulates trust-enabling power. The understanding of power as a medium is based on the evolutionary orientation of Luhmann's framework, meaning that power is among those means that emerged as a consequence of the need to cope with increasing complexity (Borch 2005).

Moreover, any occurring event may, in a complex world, have an infinite number of causes and effects. Hence, was sanctioning and control of a system by another really possible then the future could be projected from the past. Consequentially, the future would not hold any alternatives to choose from. In the course of evolution the environmental causes that can be associated to certain effects within a system can become very complex (Luhmann 1984: 40). This complexity is a measure for indeterminacy (Luhmann 1984: 50). Thus, the lack of information to determine what is going to happen is in conflict with that classical idea of power where future appears determined. In addition, there can also be no hierarchy in society (Luhmann 1986: 202). Control power is exercised only over free people. The power to govern is the result of cohesion (through trust) on the basis of freedom of choice.

Governing Through Trust

The previous elaborations on trust, control and power are confirmed by Misztal (2001) who sees a natural relationship between trust and democracy, since the preferable democratic order is one that is rooted in trust relations among citizens. It is freedom that allows learning the trust required for social cohesion, which is the same as arguing in Luhmann's terms that freedom is a condition for power to emerge. Trust is between power and freedom; hence, trust connects ("lubricates") systems.

There are a number of major advantages, which trust has in the connection to democracy and related spheres. For example, besides being the key to participation in democracy and markets, trust is a vital prerequisite for democracy's capacity for stability and renewal (Misztal 2001). This becomes clear when seeing Misztal's statement in the context of the functioning of the political system of society and its future orientation in planning. Planning necessitates the existence of trust. Moreover, renewal involves changes. In the economy this might entail innovation, changes in production capacities, reorganization of work relationships, etc. Renewal necessarily requires trust to maintain social cohesion.

Nevertheless, Bijlsma-Frankema and Costa (2005) suggest the existence of at least two varying theoretical strands. One strand represents a substitution perspective while the other strand stands for a complementary perspective of how trust relates to control.

A substitution perspective implies that trust and control are inversely related. This means that more control results in less trust, and vice versa. Trust provides motivation to cooperate, increases communication and reduces uncertainties.

Thus, the more trust there is available in a relationship the less control is required, saving costs on mechanism to control and monitor. The substitution perspective is consistent with traditional views where trust and control are actually seen as equivalent mechanisms to cope with uncertainties.

On the other hand, the complementary perspective states that trust and control can actually be mutually fortified. For example, clear rules as control mechanisms can increase trust when providing a framework of secure objectives and measures. Thus, trust and control can both add to strong cooperative relationships. Bijlsma-Frankema and Costa (2005) inform that so far empirical studies have not made any results available that would support a particular perspective over the other. Thus, the theoretical understanding of how trust relates to control is not clear yet.

Following systemic ideas a substitution perspective to understand the relationship between trust and control power is unsuitable; this has to be seen in the light of the earlier finding that only free people permit control. Neither can the complementary perspective fully explain the relationship adequately; for example, can the need to sanction jeopardize trust in this complementary relationship? I suggest that a combination of both appears more suitable to understand the trust-control relationship. Particularly the meaning of negative sanctions in social systems theory becomes clear when we ask what the purpose of society and cooperation is in the first place. The answer: to increase the probability of survival. Thus, control power should motivate cohesion. The negative sanction comes about when thinking about the alternative to social cohesion: disintegration and a corresponding decreasing probability of survival. This threat clearly acts as a negative sanction and, therefore, provides an incentive to act in accordance with the request of the one who holds power. Hence, it is fear – as in "risk" society – that generates cohesion.

My approach (Fig. 8.1) is illustrated by focusing on controlling the economy from the political system's perspective. The approach takes into account that both politics and economy are autonomously operating social systems, with money circulating in the economy and power circulating in the political system. The value of money is central to maintaining trust, as has been shown earlier. Inflation erodes trust, while deflation does not make use of the trust base; in both cases investments decline, perhaps to the point where the economy collapses.

Undertaking investments, however, is the precondition for producing cohesion. The more attractive it is to use money for trading the more people will entrust the system's medium and, therefore, reproduce the system. The decision whether to use the "official" currency for trading is a free one, though, it is in the interest of the political system to keep money attractive through appropriate macroeconomic policies. These policies are split up into fiscal (government) and monetary (central bank) policies. The central bank is normally associated with the economy and, in many but not all cases, independent from the government that formulates fiscal policy. Nevertheless, the central bank observes the economy in pretty much the same way as politics does; hence, it makes sense to construct the model as if the central bank would be part of the political system (Luhmann 1988: 345).

Notice the distinction between the features that can be controlled (monetary value) and that cannot be controlled (investments). Investments, which are outside

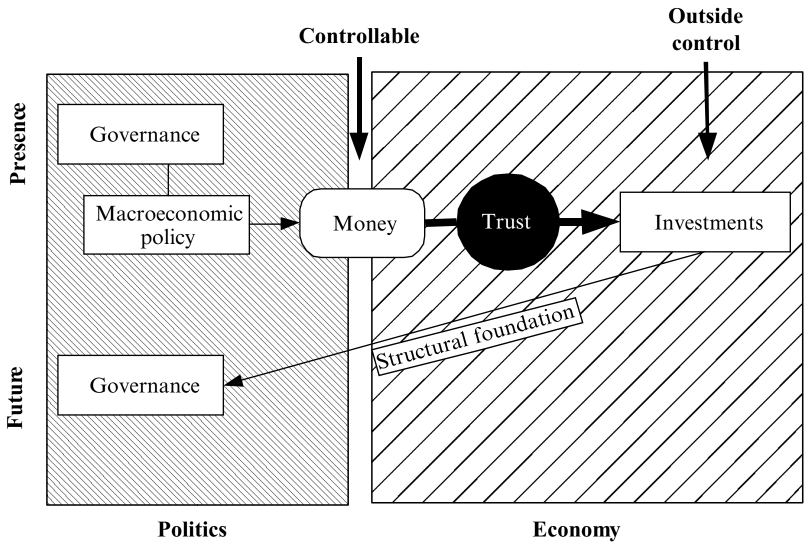

Fig. 8.1 Model of trust-control relationship

control, represent the element of freedom, which autonomously operating systems require. It is not up to politics to decide whether investments are undertaken or not. The economy must be understood to be in the environment of the political system; and the environment is outside control. If money is governed well, then trust will hopefully lead to investments (ceteris paribus: assuming other factors outside the politics-economy relationship stay equal). Although, in some cases, where governments undertake investments it is up to politics. But then politics takes over the risk for the investments, for example through compensating possible losses through taxes.

The model of the relationship between trust and control includes on the one hand the substitution strand. The availability of trust leads to a market-type economy where there is no absolute political control over investments. Thus, less control is required from the political system's point of view to maintain cohesion that yields power. However, over time the power to control can only be maintained through trust leading to investments. This is the major difference to Bijlsma-Frankema and Costa's distinction between substitution and complementary strands. Maintenance of control through trust appears more like representing the complementary perspective where control and trust are mutually reinforcing. The more trust there is at present, the higher the probability of having political control power in the future. In addition, the model offers more dynamics since it takes account of possible changes in time.

What is the consequence of undertaking investments? Investments lead to a continuity of the economy and, thus, of the needed cohesion that provides the control power for politics. Investments at present will built up a structural foundation for governance in the future. If investments are not undertaken or barter is used instead of the official currency politics will lose control power, not only over resource flows (when thinking of money as a resource governance mechanism) but also over its foundation. In that case governments will often tighten their grip and centralize functions, with a consequential loss of trust. Similar matters have occurred, for instance, in post-Soviet Russia.

The approach as presented in Fig. 8.1 is also supported by Lewis and Weigert (1985) who are of the opinion that most monetarist theories fail to give sufficient importance in their frameworks to the meaning of money as a core social institution. In the course of evolution money has developed into a commodity among others, which is supposed to obey the classical laws of economics. Money, however, functions best when people have trust in it, otherwise it cannot work well as a means of communication and a basis for cohesion. Trust is highest when it circulates without any interference. Interferences might include political manipulation of money supply through fiscal or monetary policies, interest rates, or debts financing. Such manipulations undermine trust and are far worse for the maintenance of cohesion in the long-term than any short-term advantages gained from interfering. Note that Lewis and Weigert mention political interference through macroeconomic policies and that it undermines trust. Macroeconomic policies are based on managing the monetary value through control of inflation and interest rate. Interest rates exist due to the reflexivity of money; it is possible to buy money with money. As much as this might undermine trust it also is the only way of directly intervening in the economy from outside. Thus, the goal for macroeconomic policies is to keep inflation and interest rate as low as possible in order to maintain trust. This tension illustrates how difficult it must be to "do" politics while maintaining the attractiveness of the economy for investments.

A Platform for Conflict Resolution?

Environmental Justice as Environmental Governance

Having elaborately reviewed and developed an adequate idea of the relationship between trust, control and power, what are now the consequences for environmental governance? This is not the place to provide a thorough and accurate definition of environmental governance, only as much as it can be described as the "establishment, reaffirmation and change of institutions to resolve conflicts about environmental resources" (Paavola 2007: 94). Accordingly, environmental governance deals with conflicts of interest over any type of environmental resources – renewable or non-renewable – or environmental issues as much as it includes all scales of governance problems.

Given the widespread conceptualization of environmental problems as dealing with conflicts has lead to governance being focused on matters of social justice, rather than matters concerning the efficiency of natural resource exploitation. Social justice in the context of environmental governance can apply to both distributive and procedural justice (Paavola 2007). The latter might address, for example, participation issues, e.g., concerning the distribution of power in administrations in order to legitimate decision-making, while the former commonly concentrates on the distribution of resources (energy) as well as the distribution of pollution (waste) (cf. Hornborg 1998).

This particular focus of environmental governance on environmental justice – based on equality and democracy – rests on the assumption that social and environmental goals can in fact be met in an integrated way (Becket 2004). This assumption is opposed to the belief that social and environmental goals are contradictory. Examples for a working relationship include tackling the causes of health problems and poverty, coupled with a general support for jobs and economic progress. This assumes that environmental goals have in fact economic benefits, for instance in terms of energy savings and waste reduction, while at the same time there is a strong connection between environmental degradation and economic underdevelopment (Becket 2004). Justice measures might also include environmental measures, which control negative externalities, i.e. the ecological impact of society. A major objective of environmental justice, however, is to design environmental policies that are also socially just (Foley 2004). This goal can be considered a trade-off; it contains a potential conflict because it implies that environmental policies could also be unsocial. The message could also be: environmental sustainability yes, but at no great risk for social sustainability. The general idea is, though, that as long as policies are carefully developed, there will be no negative effects on any social groups – stakeholders – involved (Foley 2004).

A different approach is presented by Hornborg (1998) who combines ecological economics and the tradition of world system theory, based on Wallerstein (1974–1989) and represented, for example, by Chase-Dunn (2005). Hornborg shares the concept of environmental justice as having emerged out of the assumption that environmental problems are socially distributed. Accordingly, the study of justice in the context of environmental governance is about the inequality of exchange relationships, including inequality concerning the distribution of environmental resources and the inequality concerning the distribution of adverse effects stemming from industrial production.

Hornborgs way of understanding this inequality problem is based on the exergy concept, which refers to the quality – not quantity – of energy. Exergy is about the physical fact there is no consumption of energy as such, but merely a transformation of energy, resulting in a change of its quality (Hornborg 1998). A related concept is that of negative entropy and dissipative structures (Heylighen 1992). Dissipative structures are systems that maintain themselves against the entropy suggested by the laws of thermodynamics. Accordingly, systems must exploit energy from their environment – a higher quality of energy – and release waste to their environment – a lower quality of energy. In other words, systems exploit order and release disorder. Social systems are alike those systems described here. Thus, this relationship between a system and its environment is naturally in an imbalance.

Whether justice refers to the equal distribution of material resources, energy, or opportunities is not relevant. One can go as far as Hornborg (1998) and proclaim that ecological issues and distributive inequalities are inseparable. In any case a collective effort is needed to achieve equality and justice, which is based on a common regime, a social system. The need for an elaborate and sophisticated regime becomes even more apparent when demanding justice between humans across the globe and across generations. Simultaneously, considering the global human population, now and in the future, is associated with a complexity that can hardly be comprehended. Given global tendencies that continuously increase complexity, it is conceivable that maintaining social justice will proceed at the expense of collective efforts that aim at addressing ecological damages.

Governing Environmental Justice in a Globalizing Society

Many authors have observed several trends in recent times which will make it increasingly difficult to maintain trust. Such trends include the speeding up of market processes and globalization. These trends are accompanied by a diminishing capacity to control those changes. For example, markets which operate at a great speed do not easily allow a prediction of the outcome. In other words, under high complex conditions, investments and all their consequences cannot be predetermined. This entails higher risk and less formal control possibilities, requiring a higher decentralization. Trust, in turn, becomes increasingly important in facilitating cooperation. This is clear: as control diminishes, another mechanism must come into play (e.g., Misztal 2001; Bijlsma-Frankema and Costa 2005).

Misztal (2001) identifies the trends as being ongoing bureaucratization, an expansion of formalism and legalism; in other words, a globalization of social systems. This expansion and globalization of dominant regimes is characterized by an increase in everyday life's complexity. More complex conditions are confirmed by Blunden (2000) who describes the globalizing world as being accompanied by a growing disorder.

These trends have led to an increasing individual autonomy and an extended demand for negotiation. This is somewhat obvious as an expansion of democratic and market structures simply demand active participation and negotiation (Misztal 2001). Higher selectivity and a need to make more choices are due to the expansion of the range of the possible, enabled e.g., through technological developments (Blunden 2000). These changes make the world less predictable and, consequently, there is a higher need for trust since more technology-widening possibilities lead to higher risk of unintended consequences (cf. Walter 2007).

A less predictable world will reduce the power of governments; thus, state authorities will have difficulties to maintain people's trust. For instance, to maintain stability and power for governance, the focus of economic policy should be on the maintenance of trust. But such a policy is constrained by the pressure to accommodate accelerated economic growth, often accompanied by trust-eroding inflation (e.g., Walter 2009). Similarly, alike the economic field, environmental policy is constrained by what is possible so that trust is not threatened (Blunden 2000).

For example, making money expensive in order to decrease resource exploitation would be a considerable environmental policy to manage natural resources ecologically. However, the policy might undermine trust in the economy as investments fail to be made (Walter 2008).

The difficulty of authorities to exercise power in order to predict outcomes of their policies has led already to the emergence of new modes of governance where the state is emphasizing a rescaling of its activities (e.g., Secretariat of the Economic Council 2006). Over time this could lead to a higher pressure to relocate more and more functions from the state to other actors, be they regional authorities or private individuals. This has to be understood under the premise that if the state does not function well others have to take over its tasks (Agrawal and Lemos 2007). Thus, the globalization process constitutes a positive feedback loop for the erosion of centralized power, a source of power, which is perceived as the guarantor for equality.

What About Ecological Modernization?

What remains to consider in this section is the situation with environmental policies, which address other than justice issues. The other large group, besides environmental justice policies, is policies aiming at efficiency. Generally speaking, the globalizing tendencies, which have conquered the economy perhaps more than any other societal sphere, make it rather easy to implement efficiency measures into production processes. More efficient enterprises are more competitive since they can produce at lower costs. And competitiveness is one of the most eminent issues that organizations face in a global society. Research and development departments are particularly concerned with this issue.

Ecological modernization as an environmental strategy emerged out of this context of increasing complexity, which demands a fostering of competitiveness and decentralization of decision-making (i.e. “marketisation”). Accordingly, ecological modernization is based on the need to modernize when operating in markets and is strongly innovation oriented. However, the idea behind it as a strategy is to accelerate the technological progress, but simultaneously founded on the assumption that environmental problems can only be solved through marketable solutions, which aim at increasing the productivity of resource utilization. The goal is essentially to produce so-called win-win situations, where technological progress is good for economy, society and for the environment. Thus, it is very much a political concept (Jänicke 2008). This is even truer given that ecological modernization does require influence on the direction of progress; though, due to the world’s growing complexity, ecological modernization is relying heavily on the market as a regulating factor where uncertainty drives progress (Murphy 2000).

The model on the relationship between trust and control shares the assumption of ecological modernization theory that environmental policy is only possible through marketable solutions, which means nothing else than as part of a continuously trustful society. Thus, ecological modernization is the most probable way to go ahead because it has the strength to maintain trust and cohesion. This is not surprising as it is the goal of the state/polity to maintain a cohesive regime, for instance to ensure a platform for justice, etc. Hence, environmental policy measures are only acceptable in so far as long as such a governing platform can be sustained.

The success of ecological modernization can be explained by its orientation as a collectivist strategy. It does not challenge the basic established regime of networks and dependencies and the efficiency seeking societal configuration (cf. Stewart 2000). Not addressing the individual, society assumes responsibility. Consequentially, ecological modernization emerges as an approach that maintains trust and cohesion under an accelerated evolution of complexity. It is an effort to remove or minimize possible conflicts that could surface out of dealing with the existing dependencies in society and, hence, provides a continuing basis for social justice. The strategy is – so to speak – sustaining the status quo between an exploited environment and an exploiting society (e.g., following Hornborg 1998).

This consequential problem is confirmed by Jänicke (2008) who points out that increases in resource efficiency actually might feedback and lead to increases instead of decreases in resource exploitation and possible corresponding emissions. Following systemic considerations in the analysis of innovation provides an important insight into the demands set by technology regimes. Once an innovation becomes accepted a regime starts to stabilize by evolving into a dependency network (Leydesdorff 2000). New innovations and more knowledge increase complexity, thereby decreasing the probability of planning any outcome. The provisional nature of true knowledge generates a continuous pressure to accumulate new knowledge and to innovate (Leydesdorff and Meyer 2006). Luhmann has formulated the consequence of this need in writing that science becomes the means through which the world becomes uncontrollable (Luhmann 1990: 371).

A look at twentieth century extraction of non-renewable resources confirms this. In spite of an increased extraction of many such resources long-term prices have been rather stable. This is due to the application of knowledge and the improvement of extraction and utilization technologies (Wils 2001). Hence, innovation can lead to an acceleration of resource exploitation, where acceleration means an incremental increase of resources exploitation per time unit, as happened during the twentieth century. Similarly, Braungart et al. (2007) argue that the former East Germany has been – due to its inefficient industry – much more effective in conserving environmental resources than West Germany, which exploited the environment far more due to its highly efficient industrial facilities.

Hence, solving environmental issues on the basis of improving the efficiency of resource exploitation and waste emissions is restricted by the problem of dependency on social networks. Eliminating ecological issues would require a removal of the boundary between society and its environment or, in other words, the boundaries of the mentioned dependency networks; for it is boundaries that produce conflict. Given the globalization process, under which trust is increasingly difficult to maintain and, thereby, making it already difficult to implement justice policies, it will be increasingly improbable that politics would implement measures that address the dependencies in order to break them. This has to be understood in the light of the conditions of trust maintenance. It is after all due to cooperation between humans through generalized media of communication that trust is bestowed at all.

Conclusion

In the course of evolution cooperation has expanded over time and space, necessitating the emergence of mechanisms that would permit translocal cooperation in more complex conditions. Not only allow these mechanisms governance over wider scales, spatial and temporal, they are also a condition for achieving justice. To make it clear, how would it be possible otherwise to achieve justice between large numbers of people if these people would not interact as part of a large scale cooperative regime? Hence, governance necessitates a cohesive society.

However, the limits for change in society reflect directly the discussion on willingness to change. The fragile position of governance capacity based on freedom of choice is clearly depicted in the introduced model on the relationship between trust, control and power since there is a clear choice between bestowing trust and not doing so. This is why it is so important for polity to maintain trust in policies and general societal rules. Otherwise power is degrading. While freedom of choice, so to speak, grants power to the collective, the latter then produces limitations to (societal) change. The collective has its own way of functioning. The whole is, after all, more than just the sum of its parts.

Concerning environmental governance efforts, it appears environmental programs' different objectives can be put together, incorporated, for instance, into a common framework called sustainable development. Given that sustainable development requires the maintenance of governance capacity, it must necessarily be organized so as to enjoy broad support, for example to emphasize social justice, equality, etc. between people. The idea that justice can lead to environmental sustainability is based on the assumption that justice is equal to justified policies – meaning, it is morally correct to protect both environment and people from the unfairness of the world. Moreover, if morality is subject to evolutionary constraints, would it be surprising to find that what is seen as being morally correct is concerned with preserving cooperation?

Social evolution has caused complexity to increase within social systems and, therefore, there are more choices to be made nowadays. More choices naturally entail increases in risk. While the nation-state concept appears to lose meaning, the very functioning of the state depends on the maintenance of trust in it and cooperation. Thus, trust will be increasingly required to maintain cohesion under great and rapid changes. Maintenance is at the center of a dynamic approach to understand state or political agency addressing the collective; it is a concept that assumes that it could also be different. Disintegration is what can happen if maintenance does not take place. The model framework on trust and control that I have presented offers this dynamism and has a strong focus on maintenance. Moreover, due to the consideration of the complexity increase it sheds light on the need for trust as a lubricant of social relationships and as a provider of power for society-wide planning. Hence, it appears that it will be increasingly less probable that any measures that threaten the trust requirements for translocal cooperation will be implemented.

The trends towards globalization and rising complexity and their corresponding problems point out the basic conflict that exists, which is the boundary between dependencies and their environment. When viewing society as a regime of dependencies, maintaining trust and cohesion will more and more be the priority of policy making. Any environmental policies that aim to address the reduction of society's impacts on the environment would need to aim at weakening or breaking those dependencies. Hence, it is not surprising that environmental governance of the collective reality is seeking the opposite: the integration of society and environment.

From the elaborations in the article it appears that environmental governance is first and foremost about maintaining future governance; hence, it is about the potential to govern in the future. While environmental governance, for instance as expressed in ecological modernization, has the good intention of improving the society-environment relationship, the elaborations suggest that this approach, alike other governance solutions, is ensuring that conflicts (always between people) are kept at a minimum. Following the earlier descriptions there is a threat that ecological modernization results in a cementing of the society-environment difference due to the dependencies it causes. This implies that this strategy (alone) is unlikely to be successful in decreasing environmental impacts.

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Chapter 9
Rational Choice Theory and the Environment: Variants, Applications, and New Trends

Ulf Liebe and Peter Preisendörfer

Abstract Rational choice theory (RCT) is a research paradigm based on methodological individualism. Collective phenomena are explained by assumptions about the behavior of (subjectively) rational individual or corporate actors. In environmental research, RCT is used to predict ecological perceptions, attitudes and behavior on the micro level, and to shed light on environmental outcomes on the macro level. The most fundamental insight from RCT is that environmental problems are often the result of a social dilemma, that is, individuals' purposive action leads to unintended negative collective consequences. This chapter addresses variants of RCT including game theory, shows applications in the field of environmental sociology on the micro and macro level, and points to new trends in RCT such as neuroeconomics and happiness research which may also be useful for environmental sociology.

Keywords Rational choice theory • Game theory • Social dilemmas • Neuroeconomics • Happiness research

Introduction

Rational choice theory (RCT) has a long tradition that can be traced back to the origins of the social sciences. Indeed, RCT has to be considered a multidisciplinary approach developed and applied by, among others, economists, political scientists, and sociologists. Over many decades, RCT has made valuable contributions to various fields of sociology such as "family and demography", "organizations", "crime and deviance",

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and "political sociology" (cf. Hechter and Kanazawa 1997). Not surprisingly, RCT has also contributed to environmental sociology and environmental research. In this research area, RCT is used to explain ecological perceptions, attitudes and behavior on the micro level, and to predict environmental outcomes on the macro level. The main aim of RCT is to explain collective outcomes. One fundamental insight from RCT is that environmental problems are often the result of unintended consequences of individuals' purposive action. Such unintended consequences may arise, for example, from car use and its cumulative impact on air quality.

This chapter addresses variants of RCT, shows applications in the field of environmental sociology, and points to new trends in RCT and the environment. In the second section, we give an overview of RCT including basic concepts and different variants. This overview highlights important aspects although it is far from being comprehensive. Applications of RCT in environmental sociology are discussed in the third section. These encompass the explanation of environmental behavior, the correlation between environmental attitudes and behavior, time discounting, environmental problems as social dilemmas, and the economic valuation of environmental goods. The fourth section refers to two recent trends in RCT, namely neuroeconomics and economic happiness research, which may also be useful for environmental sociology. The chapter ends with some concluding remarks.

Principles and Variants of Rational Choice Theory

RCT is a research paradigm based on methodological individualism. This means that collective phenomena are explained by assumptions about the behavior of individual actors, where "individual actors" may also refer to organizations, governments, or other corporate actors. A well-established systematization of rational choice explanations is the so-called *macro-micro-macro model* (Coleman 1986) which is illustrated in Fig. 9.1. According to this model, explanations of collective phenomena consist of three steps (Coleman 1990: 19; Esser 1996: 93; Hedström and Swedberg 1998: 21):

1. The "macro-to-micro transition" (logic of situation/situational mechanism), that is, how conditions on the macro level, namely, a specific social situation, affect the individual.
2. The "purposive action of individuals" (logic of selection/action-formation mechanism), that is, how individuals generate a specific action, given their desires, beliefs, action opportunities, and their perceptions of the social conditions.
3. The "micro-to-macro transition" (logic of aggregation/transformational mechanism), that is, how individual actions and interactions generate a macro-level phenomenon.

Although many applications of RCT in environmental sociology focus on explaining individual behavior, for example, recycling participation or travel mode choice, it should be emphasized that RCT is primarily concerned with collective outcomes.

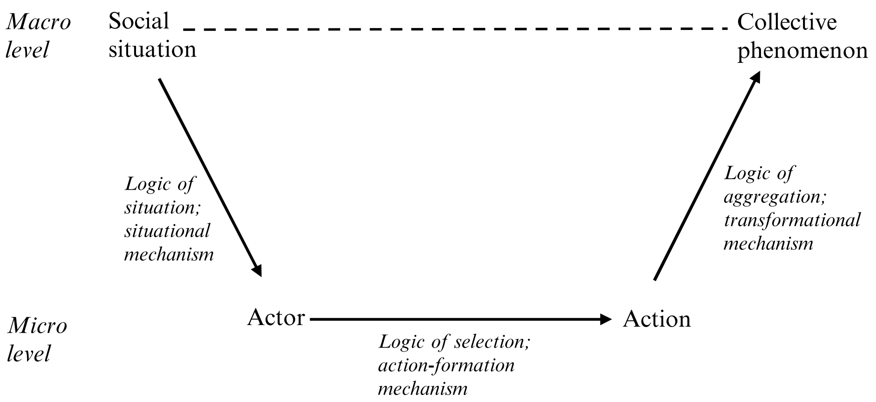

Fig. 9.1 Logic of rational choice explanations of collective phenomena

With regard to the environment, these collective outcomes include global ecological problems such as the greenhouse effect, the reduction of biodiversity, or the overfishing of the oceans.

There is no single RCT, but several variants mainly differing in their rationality criteria on the micro level.[1] Nevertheless, all RCTs agree as far as the following *three core elements* (cf. Diekmann 1996: 91) are concerned: First, actors are the starting point of explanations. Second, actors can choose between at least two alternatives of action. Third, the theory contains a decision rule stating which action is chosen by the actor. RCTs differ in the decision rule used and, hence, in the way the action-formation mechanism is modeled. The most common assumption is that, given an opportunity set of actions, an actor will choose the action that "best" satisfies her interests. The opportunity set of actions is determined by restrictions such as time and income or, in general, by structural conditions and institutional arrangements (Voss and Abraham 2000: 54). The phrase "the action that 'best' satisfies her interests" does not exclude decision rules that operate without the assumption of selfishness (e.g., in models of altruistic behavior, Margolis 1982) and without the principle of utility maximization (e.g., in some models of bounded rationality, Simon 1979; Rubinstein 1998).

Elementary RC versions (most clearly the idealized homo oeconomicus) assume selfish actors who are endowed with preferences that fulfill certain rationality postulates and who strictly maximize their utility. Important rationality postulates are that preferences are complete and transitive (if an actor prefers x to y, and y to z, she also prefers x to z). Given this, preferences can be represented in an (ordinal) utility function.[2] In situations that involve risks and uncertainty in the form that

[1] For sociologically oriented review articles on RCT, see Hedström and Swedberg (1996), Hechter and Kanazawa (1997), Voss and Abraham (2000).

[2] In fact, the existence of a utility function representing some preference relation on a *countable* set is characterized by these two axioms. However, a complete and transitive preference relation on an *uncountable* set might not have a representing utility function (Rubinstein 2006: 16).

each outcome is realized with a given and known probability (so-called "lotteries"), actors are assumed to maximize their expected utility. If probabilities are not (objectively) given, rational choice researchers rely on the concept of subjective expected utility (SEU theory).[3]

SEU models, as used in sociological and social-psychological research, implicitly assume that actors are able to assign subjective probabilities and utilities to outcomes of actions and to compare the subjective expected utilities of different alternatives. For an action alternative, the SEU is the sum of the perceived probability of each outcome multiplied by the utility of that outcome. Facing different actions, actors choose the alternative with the highest SEU value. This is illustrated in Table 9.1 which gives a hypothetical example referring to a person finally choosing air travel for a trip from Berlin to Paris. The alternatives considered are car, rail, or airplane. The consequences refer to time, comfort, and cost. (Other outcomes such as environmental impact could also be taken into account.) Travel time is the most important decision criterion for our actor, followed by comfort and costs. The subjective rankings reveal the order of airplane followed by rail and then car for travel time; the order of rail, followed by airplane and then car for comfort; and the order of airplane followed by car and then rail for cost. Choosing the alternative with the highest net utility (SEU value), the traveler will use the airplane.

The SEU framework is widely used in environmental sociology. However, there are different specifications and testing strategies. Researchers often include non-selfish

Table 9.1 Application of a SEU model to a travel mode choice for a trip from Berlin to Paris

Mode	Outcomes	Evaluation of outcomes (B)	Subjective probabilities of occurrence (p)	$p \times B$	$\sum p \times B$
Car	Fast	0.9	0.6	0.54	
	Comfortable	0.7	0.5	0.35	1.17
	Cost-saving	0.4	0.7	0.28	
Rail	Fast	0.9	0.8	0.72	
	Comfortable	0.7	0.7	0.49	1.45
	Cost-saving	0.4	0.6	0.24	
Airplane	Fast	0.9	0.9	0.81	
	Comfortable	0.7	0.6	0.42	1.55
	Cost-saving	0.4	0.8	0.32	

Note: It is possible to obtain the evaluation of outcomes and the subjective probabilities of occurrence empirically in a survey, using, for example, rating scales ranging from 0 = "not important at all" to 10 = "very important" for the outcome evaluations, and 0 = "totally improbable" to 10 = "very probable" for the subjective probabilities.

[3] See Schoemaker (1982) for a survey of variants. In contrast to maximizing decision rules are non-maximizing decision rules such as the principle of "satisficing" in *models of bounded rationality* (e.g., Simon 1979). Since situations are often too complex from the actors' point of view, they choose to "satisfice", i.e. to choose an action that is "good enough". In general, RC explanations can also be differentiated according to assumptions about "available information" on the part of actors (complete/perfect versus incomplete/imperfect information).

motives such as altruistic motives and “soft incentives” such as social approval (e.g., Opp 1986). A refined specification of SEU theory is also the theory of planned behavior (Ajzen 1991).[4]

Since RCT is concerned with collective outcomes, a crucial question is how the micro and macro levels are linked. This refers to the *transformational mechanism*. Often the aggregation rule simply sums up the independent individual choices explained by the action-formation mechanism. However, collective outcomes can arise from more complex transformation mechanisms. One such mechanism is elaborated by *threshold models* (or models of critical mass). They are used, among other things, to explain collective behavior (Schelling 1978; Granovetter 1978; Oliver et al. 1985). For example, threshold models assume that an individual’s decision to participate in an anti-nuclear protest depends on how many other individuals have already decided to join the protest. Threshold models may be fruitfully combined with SEU models because a threshold may be regarded as the point “where the perceived benefits to an individual of doing the thing in question […] exceed the perceived costs” (Granovetter 1978: 1422).

The micro-macro link is also considered in *game theory*, which analyses situations of strategic interdependence of rational actors. Game theory can be applied to a variety of collective outcomes, for instance, to the provision of public goods such as clean rivers. In situations of strategic interdependence, the outcome of an individual’s behavior depends not only on her behavior but also on the behavior of other individuals. Such situations often yield a social dilemma in which “individually reasonable behavior leads to a situation in which everyone is worse off than they might have been otherwise” (Kollock 1998: 183). A prominent example is the tragedy of the commons (Hardin 1968) such as overfishing of whales and sturgeon, which can be modeled as an n-person *prisoner’s dilemma* (PD; see also Hardin 1971). Figure 9.2 gives an example with regard to sustainable fishing. In a one-shot PD, defection (the “catch them all” strategy) is a dominant strategy, i.e. yields a higher payoff than cooperation (the “sustainable fishing” strategy) no matter what the other actors do (because $T > R$ and $P > S$). The result is a situation in which everyone chooses defection (“catch them all”), a Nash equilibrium with a Pareto-inferior outcome compared to everyone choosing to cooperate (“sustainable fishing”) given an interest in the public good (payoffs R,R compared to P,P where $R > P$).[5]

[4] With regard to empirical applications of SEU models, it is not necessary to measure the perceived probabilities and outcome evaluations directly. They can also be obtained or assumed by using what are known as bridge hypotheses (Kelle and Lüdemann 1998; Opp and Friedrichs 1996). A second type of bridge hypotheses is relevant for the macro-micro link. These hypotheses link the “objective structure” of the social situation with actors’ perceptions, subjective ideas, and goals (Esser 1998).

[5] Simplified, a Nash equilibrium is a strategy profile, including one strategy for each actor, such that no actor has any incentive to unilaterally change her action. In our example, the profile (“catch them all”, “catch them all”) is a “Nash equilibrium.” Note that the two-person PD in Fig. 9.2 can be easily extended to a logically similar n-person PD with more than two actors (cf. Hardin 1971).

Fisher B

		Sustainable fishing	Catch them all
Fisher A	Sustainable fishing	R, R	S, T
	Catch them all	T, S	P, P

T := Temptation

R := Reward

P := Punishment

S := Sucker

T > R > P > S

Fig. 9.2 Prisoner's dilemma and sustainable fishing

Game theoretic models include an action-formation and a transformational mechanism. The Nash equilibrium, the most prominent solution concept of games, specifies both a decision rule and an aggregation rule (choosing the equilibrium strategy; cf. Diekmann and Voss 2004: 23). Game theory is particularly useful for modeling situations that involve a large number of actors. However, it often makes a difference how actors perceive and subjectively define certain situations. For example, environmental problems may be perceived and, hence, modeled as prisoner's dilemma dilemma situations, or they may be perceived and modeled as assurance game situations (where defection is not a dominant strategy; cf. Frey and Bohnet 1996: 295).

Experimental evidence and field studies show that many individuals cooperate in prisoner's dilemma and public good games, i.e. they do not take a "free ride" as would be expected by elementary versions of RCT (Ledyard 1995; Camerer 2003). *Behavioral game theory*, a fast growing research branch, tries to give explanations for this. The underlying models introduce aspects such as fairness and reciprocity (Fehr and Schmidt 1999; Bolton and Ockenfels 2000; Rabin 1993; Falk and Fischbacher 2006; Tutic and Liebe 2009). They apply combinations of classical economic and sociological concepts. Some of the models modify the utility function, for example, by including a fairness term to capture the inequity aversion of individual actors who "are willing to give up some material payoff to move in the direction of more equitable outcomes" (Fehr and Schmidt 1999: 819).

Applications of RCT in Environmental Sociology

Many applications of RCT in environmental sociology aim at explaining *individual environmental behavior* such as recycling (e.g., Guagnano et al. 1995), energy saving (e.g., Diekmann and Preisendörfer 1991, 1998), or travel mode choice (e.g., Lüdemann 1998).[6] Competing rational choice explanations for the same kind of behavior can be found, for example, in the literature on travel mode choice. Elementary RC approaches focus primarily on the effects of incentives or, to put it more generally, on the effects of changes in restrictions on behavior. Hence, the transportation mode decision depends on travel time, comfort, and monetary costs (see, e.g., Brüderl and Preisendörfer 1995, and Table 9.1 in the second section). More comprehensive SEU models refer to Ajzen's theory of planned behavior (e.g., Lüdemann 1998; Bamberg and Schmidt 2003). With regard to the theory of planned behavior, the attitude toward the behavior (evaluation of different travel modes), the subjective norm (normative expectations of peers), and the perception of behavioral control (potential impediments/obstacles) determine the behavioral intention, which in turn determines the final behavior. Each of the three explanatory components of the intention consists of products of beliefs (subjective probabilities) and evaluated outcomes of travel mode alternatives. Extensions of the theory of planned behavior bring in, among other motives, moral norms (e.g., Harland et al. 1999; Kaiser 2006). Such extensions in the form of a multiple-motive perspective seem to be a general development in the research field (Lindenberg and Steg 2007).

Another intensively discussed issue is the *correlation between environmental attitudes and environmental behavior*. Empirical research has shown that this correlation is rather weak (Hines et al. 1986/1987). Various models have been developed suggesting some kind of moderating effect with regard to environmental attitudes and behavior. Bamberg et al. (1999) propose a framing model: "[i]n the first step of a decision, automatically-activated general attitudes should set a frame that determines both the feasible set of alternatives and the criteria that are used to choose between them. In the second step, these criteria are used to select alternatives from the feasible set" (ibid.: 21). This model is confirmed by the authors in a survey about students' travel mode decisions in Gießen, Germany. Guagnano et al. (1995) introduced the A-B-C model which combines insights from attitude theory and RCT. This model leads, inter alia, to the prediction of an interaction effect "where the main effect of attitudes [A] on behavior [B] depends on external conditions [C], with the effect of attitude approaching zero when external conditions are very strongly positive or negative" (p. 704). The A-B-C model is supported in a natural experiment with curbside recycling in Fairfax County, Virgina, USA. The so-called "low-cost hypothesis" is used by Diekmann and Preisendörfer (2003). This hypothesis states "that environmental concern influences ecological behavior primarily in situations and under conditions connected with low costs and little inconvenience for individual actors. The lower the pressure of costs in a situation, the easier it is for actors to transform their attitudes into corresponding behavior" (p. 443). The low-cost hypothesis is not restricted to applications in environmental issues, but is in fact discussed widely

[6] Note that in empirical applications it is not useful to consider environmental behavior as a "global concept" (Diekmann and Preisendörfer 1998: 80). Instead, most studies investigate specific behaviors.

in the RC literature (e.g., Kirchgässner 1992). Diekmann and Preisendörfer (2003) provide positive evidence for the low-cost hypothesis using survey data from Germany. Their findings show that environmental concern has a stronger effect on low-cost behavior (such as recycling or buying products with eco-labels) than on high-cost behavior (such as shopping or going on holiday without a car).

The study of *time discounting and time preferences* (see Frederick et al. 2002 for a comprehensive overview) is important with regard to sustainable development that takes into account the needs of future generations. Energy saving equipment, for example, is often not used because individuals have a strong preference for immediate consumption. The purchase of durable goods such as a refrigerator or a washing machine regularly implies a tradeoff between the purchase price on the one hand and the long-term operating costs on the other hand. The discounted utility model (first introduced by Samuelson in 1937) assumes that all motives determining individuals' intertemporal choices can be captured in the discount rate included in the discount function which gives the relative weight an individual attaches at time t to her well-being at time $t + x$. High discount rates indicate that individuals attach low values to the future. This is the case, for instance, if an individual buys a refrigerator that is cheaper than a comparable one but has higher running costs. One regular anomaly of the discounted utility model is the fact that individuals often have (non-constant) declining discount rates over time. This is called hyperbolic discounting and represents an overvaluation of immediate rewards. Several field studies demonstrate that individuals have implicit discount rates for air conditioners, water heaters, freezers, and refrigerators that clearly exceed market interest rates (Hausman 1979; Gately 1980; Ruderman et al. 1987; Diekmann 2001). Table 9.2 shows an example taken from a study by Gately (1980). The estimation of implicit discount rates is based on consumption data of pairs of refrigerators from three firms where the two products of each firm differ only with respect to the initial costs and the energy use (efficiency). Low-efficiency refrigerators, as compared to high-efficiency ones, have lower initial costs, but higher operating costs (electricity price per kilowatt-hour). The estimated discount rates vary between 45% and

Table 9.2 Implicit discount rates for refrigerators with high versus low efficiency

			Monthly operating cost and discount rate			
Firm	Initial cost ($)	Efficiency	3.8 cent/ kWh	Discount rate (%)	10 cent/ kWh	Discount rate (%)
Sears	478	High	$4.00	45	$10.50	120
	444	Low	$5.30		$13.90	
Whirlpool	485	High	$4.00	130	$10.50	300
	473	Low	$5.30		$13.90	
General electric	518	High	$3.80	45	$9.90	125
	475	Low	$5.40		$14.30	

Note: Data is derived from Gately (1980), Tables 1 (p. 373) and 2 (p. 374). Discount rates are based on the assumption of a 10-year product life.

300%, assuming a 10-year product life and different operating costs. Hausman (1979) shows that discount rates such as these can be associated with income. Higher income classes have considerably lower estimated discount rates.

Generally speaking, environmental problems often have the *structure of a social dilemma* because many ecological services are public goods (e.g., air quality) or can be characterized as common pool resources (e.g., allocation of water).[7] Different types of social dilemmas have been tested in laboratory experiments including prisoner's dilemma experiments, public good experiments, and common pool resources experiments (Ledyard 1995; Camerer 2003; Sturm and Weimann 2006). Some well-established findings are that both in one-shot and in repeated games individuals do not strictly "free ride" on the contributions made by others (higher cooperation level than predicted by standard theory), that communication between individuals increases the cooperation level, and that individuals use costly sanctions to punish defectors. Various models in the domain of behavioral game theory focusing, inter alia, on fairness, reciprocity and on altruistic punishment give reasonable explanations of these experimental findings (see the second section). Complementary theoretical approaches (e.g., evolutionary approaches) also urge researchers to introduce – in addition to "rational egoists" – further types of actors like "conditional cooperators" or "willing punishers" (e.g., Ostrom 2000: 141). Studies based on institutional approaches show that social dilemmas such as the tragedy of the commons can be successfully managed in local as well as global real-world settings (Ostrom 1990; Dietz et al. 2003). Some examples are collective property rules in high mountain meadows and forests in the Swiss village of Törbel, "Huerta" irrigation institutions in the Spanish city of Valencia (Ostrom 1990), lobster fishery in the US state of Maine, and the (international) Montreal Protocol on Ozone Depletion signed in 1987 (Dietz et al. 2003). Explanations of successful "cases" usually refer to institutional arrangements of self-governance. According to this perspective, empirically confirmed guidelines improving the likelihood of robust governance of environmental resources are as follows: "devise rules that are congruent with ecological conditions", "clearly define the boundaries of resources and user groups", "apply graduated sanctions for violations", "involve interested parties in informed discussion of rules (analytic deliberation)" (Dietz et al. 2003: 1910).

Economic valuation of environmental goods is another research area in the domain of RCT (see Carson and Hanemann 2005 for a survey). Economic valuation deals with the estimation of monetary values of environmental goods and services based on individual preferences. The crucial concepts are the willingness to pay (WTP) and the willingness to accept (WTA) of individual actors derived from their observed market behavior (revealed preference methods) or from responses to

[7] Public goods are characterized by "non-excludability" from and "non-rivalry" of consumption, whereas common pool resources are characterized by "non-excludability" and "rivalry". A social dilemma perspective can also be applied in studies of individual environmental behavior such as commuting (e.g., Van Lange et al. 1998; Joireman et al. 2004) and in studies of environmental activism such as protesting or contributing to environmental organizations (e.g., Opp 1986; Lubell 2002).

questions in surveys (stated preference methods).[8] Valuation studies can provide useful information for policy and management decisions (Freeman 2003: 1) because environmental protection measures may only be considered "successful if they reflect the preferences of citizens" (Garrod and Willis 1999: 4). Thus, practitioners are particularly interested in cost-benefit analyses, for example, by comparing the aggregated costs and benefits of different options of forest management. Valuation studies are also used in environmental litigation (Loomis 1999; Carson and Hanemann 2005). Economic valuation incorporates non-market commodities and non-use values such as the existence value, i.e. an individual's WTP for an environmental resource due to the mere knowledge that this resource is protected although the individual will never use it (Krutilla 1967; Bateman et al. 2002: 28). This prevents an underestimation of the total economic value of environmental goods that would otherwise only include use values that can be obtained via (observed) market behavior of individuals. Non-use as well as use values are measured by stated preference methods such as the contingent valuation method or choice experiments (Bennett and Blamey 2001; Bateman et al. 2002). These methods rely on surveys which more or less directly ask people for their WTP or WTA for (a change of) an environmental good on so-called "hypothetical markets". Hypothetical market scenarios give a detailed description of the good (the current situation and the situation after a change has occurred), as well as information about the institution that provides the good, specify the payment vehicle (taxes, contribution to a fund, etc.), and describe the timing of provision of the good. Applications can be found for almost all OECD countries and for many developing countries (cf. Carson and Hanemann 2005: 842). They deal with issues such as "increasing air and water quality; reduced risk from drinking water and groundwater contaminants; outdoor recreation; protecting wetlands, wilderness areas, endangered species, and cultural heritage sites; […] and provision of basic environmental services such as drinking water and garbage pickup in developing countries" (Carson 2000: 1413).

New Trends in RCT and the Environment

This section addresses two emerging fields within RCT that are promising for environmental sociology. These fields combine interdisciplinary research from economics, sociology, psychology, and neuroscience and refer to (1) neuroeconomics and (2) economic happiness research.

[8] For example, if environmental quality is improving and the property rights are assigned to the status quo, WTP refers to the welfare measure "compensating variation" and is the maximum amount an individual is willing to pay to achieve the environmental improvement. Thus, the WTP amount brings the actor's utility level back to exactly the status quo (the situation before the change).

In recent years, the growing field of *neuroeconomics* has been bringing methods and concepts from neuroscience and economics together (see Camerer et al. 2005 for an overview). Economists have been convinced for a long time that preferences and beliefs cannot be measured directly or at least are difficult to measure. Nevertheless, preferences may be revealed by observing individuals' actions (revealed preferences) or by looking at answers in surveys (stated preferences). Although such approaches are widely used, for example, in the valuation of public environmental goods (see the previous section), many researchers are still skeptical about their reliability and validity. Traditional economic thinking tends to see individual actors and their internal functioning as a "black box".

Contrary to this, neuroscience attempts to give insights into the working of the brain and aims at "direct measurement of thoughts and feelings" (Camerer et al. 2005: 10). In other words, neuroscience opens the black box of individual decision making in economic and other social contexts. The "long-run goal of neuroscience is to provide more than a map of the mind. By tracking what parts of the brain are activated by different tasks, and especially by looking for overlap between diverse tasks, neuroscientists are gaining an understanding of what different parts of the brain do, how the parts interact in 'circuitry', and hence how the brain solves different types of problems" (Camerer et al. 2005: 14). Combining neuroscience and economics, neuroeconomics intends to gain deeper insights into the interplay between controlled (i.e. cognitive) and automatic (i.e. affective) processes and hence into the foundations of (social) preferences, trust, and cooperation.

Brain imaging is the most frequently used method in neuroeconomics.[9] Applying this method means that brain images are taken while individuals perform certain tasks (experimental and control tasks). The images show which brain areas are activated by different tasks. The most common brain imaging method is functional magnetic resonance imaging (fMRI) "which tracks blood flow in the brain using changes in magnetic properties due to blood oxygenation (the 'BOLD signal')" (Camerer et al. 2005: 12). In spite of considerable progress, brain imaging is still far from being able to derive a detailed picture of human brain activity.

Applications of neuroeconomics relevant for environmental research mainly pertain to studies on time preferences and to the study of behavior in dilemma games (McClure et al. 2004; Fehr and Camerer 2007). Whereas the discounted utility model is able to explain intertemporal choices which are primarily determined by rational calculation, it is less powerful concerning the explanation of intertemporal choices driven by affective processes or emotions. Neuroscience may help to overcome this weakness. The theory of hyperbolic discounting (i.e. the overvaluation of immediate rewards) has been tested in a study by McClure et al. (2004) using fMRI. They presented subjects with a series of monetary reward options (early versus later rewards)

[9] Besides brain imaging, other neuroscience methods are (Camerer et al. 2005: 11): single-neuron measurement, electrical brain stimulation, investigating psychopathology and brain damage in humans, and psychophysical measurement (heart rate, blood pressure, etc.).

of the form "\$ R available at time delay d" and "\$ R' available at time delay d'" where \$ $R <$ \$ R' and $d < d'$. Monetary amounts ranged from \$5 to \$40, the time delays from 2 to 4 weeks. The results indicate that time discounting is influenced by the combination of two neural systems. All choices activate cognitive brain processes (regions of the lateral prefrontal cortex and posterior parietal cortex), but choices with immediate rewards additionally activate affective brain processes (paralimbic cortex). Furthermore, cognitive brain areas show more activity when subjects select delayed rewards over alternatives that are available immediately.

According to Camerer et al. (2005: 41), neuroscience may give three main insights into the study of intertemporal choices: First, it might lead to a better understanding of the concept of time preference, for example, with regard to the correlation between time preferences and intelligence (ability). Second, it might help to predict under what conditions or in which situations individuals' choices are affected by emotions. Third, it might be able to identify individual differences in the availability of factors influencing "viscerally driven behaviors". Such insights could be used to develop incentive structures that weaken the role of time discounting and hence contribute to sustainable consumption patterns.

Neuroeconomics is also important for understanding the mechanisms behind solving social dilemmas such as the tragedy of the commons and the protection of collective resources (de Quervain et al. 2004; Fehr et al. 2005; Fehr and Camerer 2007; Spitzer et al. 2007). As pointed out in the second section, several theories of social preferences attempt to explain experimental findings which indicate that individuals often deviate from standard RC predictions. For neuroeconomics "[o]ne of the central questions [...] is how the brain constructs decision utilities when a person's behavior reflects their own rewards but is also governed by competing motives, such as warm glow altruism, reciprocity or inequity aversion" (Fehr and Camerer 2007: 420). One example is a study on the neural basis of social cooperation conducted by Rilling et al. (2002). Using fMRI they scanned 36 women playing the repeated prisoner's dilemma game with a computer or with a human partner. One finding was that mutual cooperation, especially with a human partner (as compared to a computer), has a rewarding effect induced by the activation of reward-related brain areas. Such findings support theories of reciprocity and inequity aversion if these theories are interpreted in such a way that mutual cooperation has a "special reward value" (Fehr and Camerer 2007).

Economic happiness research is also a developing and growing field (Frey and Stutzer 2002a, b) and has a long tradition in the quality of life research in sociology and psychology. Economic proponents of happiness research argue that "[h]appiness is considered by most people the ultimate goal in life" and that "reported subjective well-being is a far better measure for individual welfare" than traditional measures such as income (Frey and Luechinger 2007: 219). Economic happiness research is primarily interested in stable states of happiness such as general life satisfaction and not in sporadic (feelings of) happiness. It is based on an action model that conceptualizes individual rationality "as the maximization of ex post happiness, and not in terms of consistent preferences" (Sugden 2005: 11).

With respect to the protection of the environment, the most important application of economic happiness research can be found in the field of valuation of environmental goods. Due to the anomalies in stated preference methods, proponents of economic happiness research doubt that willingness to pay responses in surveys accurately measure decision utility (as assumed by these methods). They suggest alternative or (at least) complementary methods to value public goods, most often the "life satisfaction approach" (Frey et al. 2004; Welsch 2007): "In essence, individual life satisfaction is regressed on a variable capturing respondents' exposure to the public good or externality of interest, respondents' household income and a vector of personal characteristics and other covariates. The estimated coefficient for the public good and for income can be interpreted as the marginal utility of the public good and the marginal utility of income. This allows for estimating the marginal rate of substitution between income and the public good and hence the relevant welfare measures" (Frey and Luechinger 2007: 229).

This life satisfaction approach is used, for example, in a study by Welsch (2006) which analyses the welfare effects of changes in air pollution. In addition to "objective estimates" of air pollution in ten European countries, Welsch uses information about individuals' life satisfaction derived from the Eurobarometer Survey Series, a representative public opinion survey. The exact question in the survey is: "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead" (p. 804). For the period 1990–1997, the study shows significant effects of air-polluting substances (nitrogen dioxide and lead) on life satisfaction in the ten countries. Based on this, it estimates monetary values of improvements of air quality. Table 9.3 shows some findings for air pollution with regard to NO_2.

Table 9.3 Monetary values of changes in air pollution (NO_2 concentration) between 1990 and 1997 in ten European countries

Country	% change in NO_2 concentration	Change in life satisfaction	Equivalent surplus of change in NO_2 concentration	
			$	% of per capita income
Belgium	−14.0	0.025	894	4.1
Denmark	−10.5	0.022	649	3.1
France	−8.5	0.015	500	2.5
Germany	0.0	0.000	0	0.0
Greece	−11.6	0.019	398	3.4
Luxembourg	−16.6	0.034	1,858	5.1
The Netherlands	−9.2	0.018	541	2.7
Portugal	58.3	−0.069	−1,576	−11.8
Spain	−29.0	0.056	1,554	9.8
UK	−7.9	0.014	442	2.3

Note: Information is taken from the study by Welsch (2006), Tables 2 (p. 808) and 3 (p. 809). NO_2 is the chemical symbol for nitrogen dioxide. Life satisfaction was measured on a scale ranging from one to four. The changes in life satisfaction and the equivalent surplus values were estimated using regression analyses.

It can be seen that NO_2 concentration decreased in the period 1990–1997 in most countries except Portugal (where the concentration clearly increased) and Germany (where the concentration did not change). In the same period, life satisfaction increased when the NO_2 concentration decreased. Spain, for example, experienced a decrease in NO_2 concentration of 29% connected with an increase in general well-being of 0.056 points on the life satisfaction scale.[10] Table 9.3 also shows the equivalent surplus of a change in NO_2 concentration, that is (given an unchanged level of well-being) the amount of income that compensates an individual when the decrease/increase in NO_2 concentration would not have been observed. The estimated monetary values for an average person (measured in \$ and in % of the per capita income) can be qualified as substantial.

Concluding Remarks

Focusing on conflicts between economy and ecology and on "limits of economic growth", early proponents of environmental sociology were skeptical about RCT because this theory has its origin in traditional economic thinking. This has changed in recent years as it turned out that it is hard to find a viable alternative to the idea of a "green capitalism". Natural resources are scarce and valuable goods that provide indispensable services. Therefore, their prices must "tell the truth" (e.g., take into account external effects and reflect the total socio-economic value), and only well-designed incentives can stimulate environmentally responsible behavior by individual and corporate actors. Most conflicts between economy and ecology disappear when we switch from a short-term to a long-term perspective.[11]

RCT has the advantage that it makes it possible to conduct sophisticated theoretical analyses of environmental issues as well as giving practical suggestions of what could and should be done. Concerning theory, the social dilemma understanding of environmental problems and methodological tools of game theory for analyzing such dilemmas seem to be the most important contribution of RCT. It is also RCT that most clearly shows that under certain conditions markets and market-based measures fail and that under these conditions political intervention may be good advice. Concerning practical solutions, economic, social and moral incentives are needed to pull or push economies and societies in the direction of sustainable development.

Acknowledgment We would like to thank Andreas Tutic for critical comments.

[10] Of course, the possibility of spurious correlations between changes of environmental conditions and changes of life satisfaction is always a major issue for these types of analyses.

[11] Note that economic incentives can sometimes have contra-intuitive effects, e.g., by crowding out intrinsic motivation (Frey 1992; Frey et al. 1996). Thus, "tradeable permits" with regard to environmental pollution might be perceived as a "license to pollute" and "may even be perceived to imply that those who, for reasons of environmental ethics, do not pollute as much as the permits allow, are irrational" (Frey 1992: 171).

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Chapter 10
Environmental Knowledge and Deliberative Democracy

Luigi Pellizzoni

Abstract Deliberative democracy is spreading in environment-related policy-making as a reply to the legitimacy crisis of traditional policy processes; a crisis where the saliency of uncertainty plays a major role, and which brings into question the dominant division of labor between science, politics, business and society at large. In this chapter the basic understandings, features and limits of public deliberation as applied to environmental issues are discussed. 'Proper' deliberations are difficult, there are systematic mismatches in the way uncertainty is addressed, and the traditional expert-layperson divide is usually reproduced within deliberative arenas. Innovative perspectives have been proposed, yet they downplay what dismantling the institutionalized separation between production and uses of knowledge may imply, possibly decreasing public scrutiny and undermining 'weaker' interests and insights. The potentialities of deliberative democracy are likely to flourish not only as a result of procedural refinements, but of broader societal reforms.

Keywords Deliberative democracy • Knowledge • Risk • Uncertainty • Science–policy relationship

Introduction

In recent years deliberative democracy has spread to a remarkable pace in environment-related policy-making, affecting especially the way democracy meets scientific expertise. Science has for long time been understood as the social enterprise specialized in producing explanatory and predictive knowledge – the latter being of obvious policy relevance. This has been brought into question by the

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growing import and saliency of environmental threats, as a 'side effect' of techno-science (Beck 1992). The result is what is often described as a paradoxical relationship between science and society. According to the European Commission 'expectations of science and technology are getting higher and higher… [yet] advances in knowledge and technology are greeted with growing skepticism, even to the point of hostility' (European Commission 2000: 5). This statement is supported by empirical evidence. Social surveys like the Eurobarometers (e.g., 2005a, b) show that, while science enjoys a positive image, it is not seen as a reply to every problem or a carrier of unquestioned, generalized benefits. Citizens are increasingly concerned with the unfair distribution of the goods and bads of innovation and the intertwining of science, politics and business; they also regard scientists as provided with too much decisional power and too little responsibilities. If modern science has developed on the basis of an 'unspoken contract' between science and society, such contract seems therefore to require some revision. 'New relationships are needed that fit the new mould of science, technology and society' (European Commission 2000: 5). To many deliberative democracy represents a sound reply.

In this chapter I reflect on the connection between environmental knowledge and public deliberation. I start by describing the distribution between cognitive abilities and disabilities implied in the 'social contract of science', suggesting that the demand for and offer of participation depends on a crisis of this alleged division of social labor, with uncertainty leading to growing policy ineffectiveness and questionableness. Coming to terms with uncertainty has become a pressing issue. Some trace it back to risk or confine it into suitable social realms; for others uncertainty blurs the traditional divide between matters of fact and matters of concern, entailing for the science-policy relationship to be thoroughly rethought. Here environmental knowledge meets deliberative democracy. I describe the basic understandings and pros and cons of public deliberation. Then I focus on some features of the application of deliberative arenas to environmental issues, namely: the role of scientific expertise, the configuration of deliberative games and the presence of institutionalized biases with respect to the treatment of uncertainty. Deliberative processes may be 'inclusive' but they usually reproduce the traditional division of labor between production and use of environmental knowledge. This has been criticized by part of social science scholarship, committed to supporting an innovative perspective. The latter, however, raises questions of its own, that I briefly address in the conclusion.

Environmental Knowledge and the Dominant Cooperative Scheme

All societies are characterized by what Buchanan (1996) calls a dominant institutional infrastructure for productive interaction or, more simply, a 'dominant cooperative scheme' (hereafter DCS). A DCS is a legitimized division of labor, the allocation of abilities and disabilities connected with socially relevant tasks or functions. A DCS expresses a solidarity system, with related delegation of assignments and distribution of rights to hold social positions, handle collective questions, and accede to material and immaterial resources. Abilities and disabilities design a chessboard of communicative spaces. What for able agents is a space of discussion, for disabled ones is a black box, to which they may just address 'questions' (instances, concerns, etc.) to get suitable 'answers' (issue definitions, technical solutions, policy decisions, etc.).

A DCS specifies who and how is to be involved in what type of collective enterprise relevant to a given community. The emergence of a demand for participation, then, means that some aspect of the DCS – for example as regards environmental governance – is brought into question. It indicates a rift in the structure of social solidarity; a weakened legitimacy of the division of labor; a decline in the sense of belonging and the collective sharing of responsibility for decisions taken on behalf of a whole constituency; a request of more equitable arrangements. Some, formerly disabled and excluded, ask for acknowledgment and inclusion. Meeting this demand entails a distribution of power: a break in hierarchy, a reduction in the distance between or isolation of social actors. Historically, democratization consisted in the gradual extension of citizenship rights to broader constituencies, as an answer to conflicts stemming from lack of active inclusion in the political life (Dahl 1971) – that is exclusion from decision-making on the distributive rules of relevant resources and tasks. Talking of participatory policy arrangements, therefore, means referring to increased equality and connectedness of citizens vis-à-vis a former institutional set up.

Classical and contemporary sociology stresses that a core feature of the modern DCS is rationalization and functional differentiation that is a growing specialization of tasks according to means-ends efficiency and effectiveness. A crucial aspect of this arrangement is the emergence of science, as an institution specialized in the production of knowledge about 'nature'. The independence of science implies a new way to produce and validate knowledge: no longer by means of deduction from ascertained principles governing the world order in its entirety (society and nature), but by means of testimony of material things (nature) approved by specialized peer groups (scientists as 'representatives' of society). Science deals with facts; politics and economy with values, interests, needs. As the famous dispute between Boyle and Hobbes over the air pump testifies, this represented a deep change in the social order (Shapin and Schaffer 1985). According to Weber (1958), such change has produced major effects on the legitimacy of political power: no longer is the latter based on tradition or charisma but on legality and rationality, that is on the application of appropriate technical competences according to legally validated procedures. Political legitimacy becomes in this way tightly connected with effectiveness and efficiency in the control of the world: the stronger the latter, the stronger the former, and vice versa.

The idea of a 'social contract of science', famously argued by Bush (1945) at the dawn of the post-war era and afterwards restated many times (e.g., Price 1965; European Commission 2000) can be regarded as a full-fledged, narrative expression of this division of labor. According to such a narrative[1] sound science is always premised on rational, efficient policy-making. More precisely, science represents a reservoir of knowledge to answer social needs, fundamental research leading to applied research, and applied research to concrete social benefits (Pielke 2007). The result is a linear model of the science-policy relationship, according to which professional experts sanction the facts about nature (distinguishing for example full-blown, quantifiable environmental risks from hypothetical threats) and the appropriate ways to deal with them, whereas lay people and stakeholders express interests and concerns that policy-makers are expected to address and harmonize accordingly. Sound science has nothing to do with politics; at the same time – and for this very reason – 'the policymakers' maxim should be "science first" (Forrester and Hanekamp 2006: 310). On this view, policy questions can always be reduced to quantitative risk-benefit analyses, and the basic goal is to ensure at the same time the integrity and productivity of science (Guston 2000). Crucial to this account, that recognizes a social value to fundamental research for its practical spin-offs, is the growing relevance taken by the hypothetico-deductive, prediction-focused, control-oriented model of science. Traditionally proper of physics and astronomy this model gradually spreads to sciences, like geology and biology, which were formerly grounded on an inductive, explanatory approach (Oreskes 2000).

The narrative of the social contract has a normative, rather than a descriptive, purpose: as shown by many studies, nowhere is to be found such a clear-cut division of labor. The narrative seeks to legitimize a tightening relationship between science, politics and economy stemming from a knot of matching needs: the need of money of an increasingly technology-dependent science and the need of science of increasingly innovation-dependent politics and businesses. Of course this does not mean that policy questions always require scientific insight. However, it would be naïve to take the 'scientificity' of an issue as merely depending on its intrinsic features. It is not simply because it has to do with 'nature' that environmental governance involves so much scientific expertise. Confronting ecological questions with the contested vote in Florida in the 2000 US elections (where G. W. Bush prevailed on Gore by a handful of votes), Sarewitz (2004: 397, 388) remarks that 'the vote count should have been much more amenable to scientific investigation than even the simplest environmental controversy. […] It is hard to imagine a problem more suited to a strictly technical approach': finite number of system components, simple decision rules, clearly defined spatial and temporal boundaries. However 'the dispute was not resolved by addressing the technical aspects of the vote count, but by subjecting the vote count process to political and judicial mediation procedures that were legitimated by their capacity not to arrive at "truth" but to transparently negotiate among competing players. Because this system was broadly accepted as legitimate – that is people understood and agreed on the rules – its results were also broadly accepted'.

[1] A narrative can be described as a way to make sense of the world, giving salience to and logically connecting actors, institutions, events, discursive and material aspects of society (Franzosi 1998).

In other words, it is not the intrinsic technicality of an issue that brings scientific knowledge to the forefront. Rather, late modern society seems to rely on two different mechanisms to legitimize policy decisions. One is based on institutionalized forms of comparison of values and interests, with facts selected and interpreted according to suitable normative frames. The other overlays values and preferences with technical or factual arguments, presented as normatively neutral. Choices related to a desirable state of affairs (how the world should be) are justified by referring to data and predictions (how the world actually is and how it will be if one follows a given course of action). The demarcation between facts and values, and implicitly between science and politics, works mirror-like in the two cases. In the former facts are what is to be detected and allocated after values are specified and combined. We decide first what the matter is for us, then we look for relevant evidence. In the latter case values are what remains to be specified and allocated after facts have been detected and combined. We seek first for evidence, then we look for matters of concern to be accommodated accordingly. A good deal of discursive space is therefore filled with data, technical arguments and so on, to which only 'certified' experts have access. The choice between the two legitimizing mechanism depends on widespread beliefs, authoritative statements or narrative accounts of the character of issues. Just evoking nature or health in the public arena, for example, is usually enough for framing a question in terms of 'science first'. Availability of credible procedures for allocating values in dispute also affects choice, while technical legitimacy (recognized expertise, specialized bodies, etc.) often acts as a substitute for such procedures (Sarewitz 2004). Yet it is precisely the technical path to legitimacy, and the cooperative scheme which it is grounded on, that has been questioned in the environmental field.

Risk and Uncertainty

There is actually an obvious contradiction in the linear model of the science-policy relationship. If policy presupposes science, then scientific debates become political debates, the conclusions of the former entailing answers to the latter (Pielke 2007). The more technicized becomes politics, the more politicized becomes science. This contradiction could be kept at bay as long as the disinterestedness of science worked as a major legitimating premise, and as long as science seemed provided with and effective capacity of prediction and control of bio-physical processes. Yet the first premise has been brought into question precisely by the growing intertwining of science, politics and business that the linear model sought to support and justify (Weingart 2003), while the second premise has been questioned by the increasing import of wide-ranging, long-term, unintended and unforeseen 'side effects' of techno-science – in other words by the growing saliency of uncertainty, as a feature of environmental issues that, contrary to what the linear model assumes, cannot be reduced to quantitative risk-benefit analyses (Funtowicz and Ravetz 1993; Wynne 1992). Indeed, the increasing relevance of uncertainty for the science-policy relationship is indirectly testified by the very expansion of the theme of risk. The two terms do not represent opposed polarities but define a complex semantic field where different ways of imagining the world and techniques for governing it find their place (O'Malley 2004). For example, when Beck (1992) talks of 'risk society', he refers both to the narrowing relevance of routines and traditions as a guidance to individual and institutional behavior and to the difficulty of planning such behavior according to the calculative way that established itself with Modernity.

The notion of risk spreads in the XVI–XVII centuries. Initially it refers to agent-independent threats of sailing, like storms or pirate attacks. Subsequently, risk is increasingly taken to designate events related to behavioral choices (Luhmann 1993). There may be little doubt that pivotal to this semantic drift is the emergence and strengthening of the figure of the modern rational individual: an autonomous center of decisions who, in front of an open-ended future, plans his or her action according to calculations of means-ends connections. Risk, therefore, is not only a matter of decision, but of predictability of outcomes; taking risks is deciding upon the reliability of forecasts, the controllability of events. The spread of the notion, therefore, is tightly connected with the development of probability and statistics. In the XVII century knowledge and opinion – what in medieval thinking is true by necessity, thus subject to proper demonstration, and what is true by testimony, subject to mere approval by authorities or respected judges – merge into the notion of 'natural sign': evidence given by things themselves, from which generalizing inferences can be made. Within this framework probability, as 'worthiness of approval', depends on the frequency with which predictions result correct (Hacking 1975).

If by inventing risk moderns have 'learnt to transform a radically indeterminate cosmos into a manageable one, through the myth of calculability, to reduce uncertainty to the same calculable status as that of certainty itself' (Reddy 1996: 237), to handle physical and societal processes without controlling every single element of them, the limits to prediction start to be conceptualized in the 1920s. Interestingly, the epistemic, agent-centered account of risk is retained and even strengthened. Werner Heisenberg's indeterminacy principle defines uncertainty as a limit to the measurement of physical states. For the economist Knight (1921) not only we are in front of uncertainty whenever we are unable to calculate the probability of an event, but this is hardly a negligible situation since profit derives precisely from those 'risks' which no insurance company will cover, nor any investment program can calculate. Similarly, Keynes (1921) talks of 'uncertain knowledge' and 'personal probabilities' referring to those situations, so common in economy, where no reliable probability estimates can be produced because data (be they experimental or historical, like accident or morbidity statistics) are insufficient. This idea is subsequently developed, among the others, by Savage (1954) with his notion of subjective probability, as referred – according to a Bayesan approach – to the agent's state of knowledge, instead of the character of phenomena. It thus becomes possible to 'argue that all probabilities are subjective probabilities, because relative frequencies are only sample data of past events that influence subjective probabilities of future events' (Stewart 2000: 42). In this way frequentist probabilities turn into subjective probabilities, and aleatory uncertainty blurs with epistemic uncertainty.

In other words, the possibility *for* something to happen according to 'stochastic laws of chance processes' is equated to the possibility *that* something happens according to human cognitive states, 'reasonable degrees of belief in propositions' (Hacking 1975: 12). 'Uncertainty owing to lack of knowledge is brought down to the same plane as intrinsic uncertainty due to the random nature of the event under consideration' (Dupuy and Grinbaum 2004: 10).

If epistemic accounts of uncertainty have long since become predominant, the latter has in the last decades extended its meaning beyond mere unpredictability of outcomes to encompass lack of insight into such very outcomes. Sources of uncertainty are manifold (Funtowicz and Ravetz 1993; Wynne 1992, 2007). For example, properties of a system may not be derivable straight from knowledge of its elements because of the intricacy of their interactions, while causal chains may be open-ended, with outcomes depending on unspecified or unpredictable intervening variables. We may not even know if we are putting the right experimental questions, because of our ignorance about the extension of non-knowledge.[2] Moreover, there may be disagreement on the selection of variables and methods of analysis, and more than one reasonable issue-framing. Think of climate change. Labor-intensive modeling is persistently unsatisfactory. Technological innovation may have a crucial yet hard to anticipate role in reducing anthropogenic impacts. The specific factors triggering irreversible change are surrounded by sheer ignorance. The relative importance of atmospheric and marine dynamics is a source of disagreement. The policy issue is framed in an ambiguous way – should temperature increments be discussed in ecological, economic or social terms? Should one focus on mitigation or adaptation? On modifying individual behaviors or institutional set ups?

To explain why the era of prediction and control has entered such a crisis various, possibly overlapping, reasons have been suggested. Some, for example, focus on the very advancement of science. 'Uncertainty in environmental controversies is a manifestation of scientific disunity (excess of objectivity; disciplinary diversity) and political conflict' (Sarewitz 2004: 393). It is not despite but because of the availability of sound science that we are increasingly uncertain on the knowledge suitable to address a given issue. There is too much, rather than too little, knowledge, which makes it increasingly questionable – and questioned. Different perspectives and insights can be applied to a same problem and the 'theory of everything' remains as

[2] Matthias Gross remarks that a major distinction can be drawn between the epistemic status of types of lack of knowledge where we know something about the unknown (or about the limits of our knowledge), and the status of what he calls 'nescience': a total lack of awareness of the shape, size or origin of what we do not know. Consciousness of nescience is by necessity retrospective: 'no one can refer to their own current nescience' (Gross 2007: 746). This is the type of uncertainty many scholars refer to by talking of the 'surprises' of the environment and techno-science. The line between other types of lack of knowledge and nescience corresponds to the line between predictive and explanatory knowledge. Many criticisms against current techno-science build on the idea that 'forcing' prediction into the territory of explanation – that is acting as if knowledge would be predictive instead of explanatory, by pretending to control all the 'relevant' variables at stake – is a recipe for unwelcome surprises.

elusive today as it was a 100 years ago – perhaps more. Moreover, 'the competition for the latest and, for that reason, presumably most convincing scientific knowledge produces [a drift] beyond the field of generally accepted knowledge to the front lines of research – where findings are still controversial, assertions are uncertain and open to attack' (Weingart 2003: 78). Others stress that uncertainty gains relevance because of the extended scope of human intermingling with nature. This idea lies for example behind Weinberg's (1972) concept of 'trans-science' and Funtowicz and Ravetz's (1993) notion of 'post-normal science'. The classic experimental method (laboratory-confined trial and error) is increasingly inapplicable because of the size of phenomena addressed, the implied decision-stakes and, frequently, the urgency of decisions. Facts become soft and values hard; cognitive uncertainties blur with ethical uncertainties. Moreover, uncertainty and decision-stakes may presuppose each other (Wynne 1992). The higher the stakes and the deeper the political controversies, the deeper the scientific uncertainties or the higher the levels of certainty required to decide. 'Uncertainty estimates are in part a measure of the psychological state of those making the estimate, which is in turn influenced by the political context within which the science is carried out' (Sarewitz 2004: 393). Climate change is again a typical case in point. Waste is another: decades of study of percolation from repositories have increased, rather than decrease, the controversy on the sufficiency of evidence for decision (Metlay 2000).

What these and many other environmental issues ultimately show is that an increase in scientific knowledge does not by itself reduce decision uncertainty. Attempts to reach a scientific closure of the space of discussion may clash with the politically controversial status of the issues, because of the normative assumptions underlying scientific assessments and the intra- and intergeneration distributional aspects of policy choices. The problem is not how much evidence is available but how evidence is evaluated – what counts as evidence, how much evidence is required to act – and by whom. Expert knowledge may collapse into a mess of competing claims on the existence, relevance and meaning of facts. Rather than help settling them, the search for technical legitimacy may worsen the intractability of conflicts (Pellizzoni 2003).

Uncertainty and the Science–Policy Relationship

As hinted, the response to conflicts on resource and task allocation has historically been to broaden participation in political power. The same question is at stake today with the politics of environment and techno-science. The answer however depends pretty much on the extent to which uncertainty is seen to affect the DCS.

A first reply is 'business as usual'. This entails downplaying the actual import of uncertainty. Majone (2002: 103), for example, remarks that 'if we insist that we are "completely ignorant" as to which of the events $E_1 \ldots E_n$ will occur, it is hard to escape the conclusion that all the events are equally likely to occur'. This represents a brave attempt to fix the crack opened by Knight and others in the modern pillar of predictability and control: it is not risk to be a particular case of uncertainty (one where the possible occurrence of events is calculable); rather, uncertainty is a particular case of risk (one where probabilities are all equal). Majone and others use this argument especially to criticize precautionary policies, defending quantitative risk-benefit analysis against what they regard as an unduly expansion of a regulatory discretion aimed 'to practise protectionism, or to reclaim national autonomy in politically sensitive areas of public policy' (Majone 2002: 89–90). In other words, there may be obvious interests in politicizing scientific issues; for this reason it is important to reaffirm the soundness of the linear model of science-policy relationship. This excludes any need to revise the DCS.

A different way to reassert the basic soundness of the DCS and the depoliticized status of scientific knowledge is by conceding the political relevance of scientific uncertainty, yet assigning its treatment to non-scientific social spheres. Two variants can be singled out. According to the first, a sharp distinction is to be made between risk assessment and risk management. The former is a science-based quantitative analysis. The latter weighs scientific insight against social and political considerations. In other words, risk assessment is an objective, value-neutral process that may (provisionally) fail to provide any definite response to policy questions. What to do in this case is not a scientific but a political issue. It is at this stage that 'inclusion' makes sense – especially if traditional ways to represent interests and concerns are met with growing skepticism and mistrust. This is for example the European Union's official position with regard to precaution. The latter is described as an approach to be applied to risk management 'when scientific uncertainty precludes a full assessment of the risk' (European Commission 2000: 12) and 'until all the necessary scientific knowledge is available' (European Commission 2000: 7).

The other variant of this approach gives up any sharp distinction between risk assessment and risk management, acknowledging that 'non-scientific considerations play a distinctive up-stream role setting the framing assumptions that shape the ways in which risk assessments are constructed and conducted' (Millstone et al. 2004: 7). However the experts' task remains to bring out objective elements for evaluation; that is, to shed light on policy alternatives, distinguishing those compatible from those incompatible with data. In other words, scientific questions may be framed by political ones, yet within a given frame policy options are independent of political opinions (Pielke 2007). Here experts may perform their objective, quantitative analyses.

There is however a growing number of scholars who regard uncertainty as a permanently salient condition of knowledge production on the environment. This implies for any serious controversy that definite, agreeable distinctions between facts and values (or between policy and politics) are virtually impossible. 'The ways in which we know and represent the world (both nature and society) are inseparable from the ways we choose to live in it' (Jasanoff 2004: 2). The social and natural orders are co-produced. On one side the very character of scientific knowledge has to be reappraised. Scientific objectivity means the presence of objects, that is something made able to object to what is said about it, by producing 'proofs', 'reliable testimonies' within an experimental framework (Stengers 1997).

On the other side there is a 'continual interpenetration of political choices or commitments and the production of reliable knowledge. [...] Instrumental goals, the knowledges and practices adopted for achieving them, and the applicable standards of credibility and legitimacy are all constructed together through a unitary process of ordering of the world' (Jasanoff 2005: 23). For example, in the case of the Yucca Mountain (Nevada) planned nuclear waste repository, research shows that despite repeated appeals to evidence-based policy the science used to justify choice has been influenced by politics, while the policy of site selection has been altered by the knowledge produced. A number of scientific assumptions proved controversial with further research, leading to increased complexity in the understanding of the geology of the site. This was counterbalanced by a regulatory change: from a set of independent siting criteria to an encompassing, simplified performance assessment model (MacFarlane 2003).

Yet if 'science offers a framework that is unavoidably social as well as technical since in public domains scientific knowledge embodies implicit models or assumptions about the social world' (Irwin and Wynne 1996: 2), then knowledge production is no longer to be understood as a specialized task to be entrusted to experts alone, with 'lay' actors having a say only about its policy applications – as both the risk assessment/risk management and politics/policy approaches assume. Production and use, cognitive and normative goals and assumptions, description and prescription intertwine. Knowledge production has thus to be 'democratized'. Funtowicz and Ravetz (1993) and Wynne (1992) talk for example of 'extended peer communities'. The idea is that the inclusion of all those involved in a problem-situation may improve the quality of knowledge – its fitting the bill – by affecting goal definition and evidence assessment, shedding light on the parties' stakes and assumptions about the natural and social world. Facts are to be understood in an extended sense as well, encompassing lay and local insight in its different forms. In brief, questions of values and goals are to be addressed together with questions of facts and means, with no preliminary adjudication of which is which and what pertains to whom.

Deliberative Democracy

To sum up, the need to build more inclusive policy processes is widely acknowledged, though positions differ remarkably as regards the scope of inclusion. It is no surprise, then, that many turn to deliberative democracy (hereafter DD). This expression appears around 1980, conveying the idea of a discussion between free and equal individuals. Theoretical reflections and practical experiences develop in the following years at an amazing pace. If, as Elster (1998: 1) notices, 'the idea of DD and its practical implementation are as old as democracy itself', then the legitimacy crisis of political institutions (Held 1996) and the repeated technological debacles and regulatory failures of advanced democracies (EEA 2001) may account for much of its current success.

DD differs in various respects from straightforward approaches to democracy, based on party systems and political representation. First of all, it contrasts mere aggregation of preferences (through elections or opinion surveys) with their dialogical confrontation. Elster (1995) distinguishes between two forms of dialog, bargaining and arguing. Bargaining is based on the exchange of threats and promises between self-interested actors. Its strength lies in credibility. Arguing is based on the exchange of reasons in search of the common good. Its strength lies in validity (propositional truth, impartiality, sincerity). This, for many, is what 'proper' DD is about. Arguments can be used strategically and the actors' true motivations are reciprocally inaccessible. Yet, compared to the classic negotiating table, a deliberative setting should at least benefit from what Elster (1998) calls the 'civilising force of hypocrisy'. If the participants are formally committed to looking for shareable reasons, then individual preferences have to be justified in non-selfish terms; private interests must be accommodated to publicly defendable principles.

Secondly, DD contrasts decisional aristocracy with inclusiveness. All those potentially affected should in principle take part in decision-making. A target of criticism are especially the neo-liberal reforms of late 1970s and 1980s and the 'public choice' school (Downs, Hayek, Riker, etc.) they are based on, with its stress on elitism, technocracy and strategy – the idea that democracy is not about participation but about the selection of political leaderships; that growing complexity of issues prevents citizens and even most professional politicians from grasping the technical rationale of policy choices; that politics just consists of a struggle of competing interests, to be regulated in a market-like way.

For some the appropriate place for DD is the public sphere – the informal, multiple spaces where citizens address public issues (Habermas 1992). For others DD needs proper 'deliberative arenas', that is, institutionalized domains where participants meet and discuss, face to face or virtually, according to agreed rules (Cefaï 2002). A number of deliberative models have been developed to this purpose: participatory budgeting, deliberative poll, citizens' jury, consensus conference, scenario workshop, and so on. DD here is understood, rather than a philosophical ideal of democracy, as a purpose-oriented practice. More precisely, some models take DD as a sounder alternative to traditional opinion surveys, with which they share however the source of legitimacy. The latter lies in the statistical representativeness of the deliberating group – in fact, an application of science to knowledge production. The innovative aspect, then, consists in the participants' targeted information and discussion, allegedly affecting their views on the issues at stake. Deliberative processes should produce a 'mindful', 'reflective' public opinion, leading to valuable policy recommendations. Other approaches understand DD more as a problem-solving activity, to be applied either to wide-ranging issues or – more frequently – to ill-tractable local controversies. Here the reference is not so much Habermas's idea of public sphere, as Dewey's (1927) notion of the public as a community of inquiry. In this case, more than a discursive exchange preliminary to preference expression, deliberation is seen as a practice aimed at producing a cognitive added value. Consequently, the statistical representativeness of the participants becomes less important than their ability to express (or 'represent' in a theatrical sense of the word) a significant range of concerns and insights.

The design of deliberative arenas varies, therefore, according to the concept of deliberation. For what we may call the opinion-oriented deliberation what counts most is to ensure the 'input equality' of participants (same possibility to take part, same information, same opportunity to take the floor, etc.). Ideally participants should be as similar as possible to each other, their only difference lying in the way their minds process information. The internal forum of deliberation is of paramount importance (Goodin 2000). Major attention is to be devoted to providing informational inputs free from intentional or unintentional biases, which might affect the resulting opinions. For what we may call the inquiry-oriented deliberation, on the contrary, participants should be as diversified as possible: the greater the diversity the richer the material for a joint reflection. The stress is on creating a favorable setting for collective learning and output devising (solutions to, or at least clarifications of the terms of, a question).

The deliberative opinion poll (Fishkin 1997) represents the best known example of opinion-oriented deliberative model. It uses a large statistical sample; draws on questionnaires to be filled before and after the discussion phase; provides the deliberating group with information and expert advice. An example of inquiry-oriented model is the scenario workshop (Andersen and Jäger 1999). The latter's goal is to gather insight into experiences, hurdles and visions of participants in order to single out concrete proposals on how to address an issue. No random sampling is required. Members are chosen according to their potential contribution, usually among four groups: citizens, businessmen, public administrators and experts. Citizens' jury (Jefferson Center 2004) and consensus conference (Joss and Durant 1995) share something of both the opinion- and inquiry-oriented concepts of DD. They draw on statistical sampling, pre-post deliberation polls, preliminary information and expert advice; yet a small discussion group is carved out from the sample (thus becoming a quota-sample) and the goal is to reach a consensual 'verdict' or 'position', rather than to aggregate individual opinions.

Strengths and weaknesses of DD and related models have been extensively discussed (e.g. Gastil and Levine 2005; Rosenberg 2007). It is usually maintained that public deliberation improves civicness, making people more active, informed, responsible, reflective, open to change their opinion. Moreover, by including in the policy-making those affected by decisions, DD should improve the legitimacy of policies. Also the quality of decisions can be positively affected, from both a normative viewpoint (fairness, justice) and a cognitive viewpoint (mutual learning, innovation). Inclusion, however, always represents a weak point. Participation of all those involved in an issue is confronted with problems of scale (they may be too many), identification (who they are may be unclear or controversial, depending on how the issue is defined), withdrawal (some of them may feel skeptical or uninterested; they may be short of time, money or competence; they may disagree with the agenda). As the models cited above indicate selection criteria are often applied, none of which is exempt from bias, while self-selection is hardly any better in this respect since it privileges the most resourceful or directly involved persons.

Another problem is intentional or unintentional manipulation, stemming from agenda setting, expert and information selection and group dynamics (opinion polarization, 'spiral of silence', etc.).[3] Professional organization and facilitation of discussions help address these problems, which however can never be totally overcome.[4] A further issue is that DD may be a source of policy fragmentation. The practical efficiency and effectiveness of deliberative arenas are often linked to restricting their inclusiveness and scope, at the price of increasing their externalities. A suitable solution here and now may produce negative outcomes elsewhere and later. However, broadening the scope and inclusiveness of deliberation expands also management difficulties and manipulative opportunities. Moreover, the appropriate scale for discussing a question is seldom self-evident, becoming a frequent source of controversy – think of traffic pollution or infrastructure planning, to say nothing of global warming and the like.

Finally, deliberation outputs and policy outcomes are often loosely connected. Deliberative processes are mostly consultative rather than participatory in the full sense of the word, even when provided with a problem-solving aim. Sponsors may be strongly and even formally committed to applying the results of deliberation (Smith and Wales 2000). Yet such commitments have a political, rather than legal, value.[5] Above all, deliberators cannot become actual decision-takers without undermining the role of democratic institutions, from town councils to parliaments. It thus remains an open question to what extent and how deliberative arenas may be accommodated to the traditional institutional arrangements.

Environmental Governance and Public Deliberation

Often ill-tractable, and different from usual interest conflicts, environmental questions have managed to play a pioneering role in the development and diffusion of DD – global and local ecological and techno-scientific issues are a very frequent topic of deliberative arenas around the world. However, while a huge literature is available on the general problems of public deliberation, the peculiarities of its application to environmental policies have attracted less attention. In this section I address some relevant issues, namely: role of scientific expertise, game configuration and institutionalized biases with regard to the treatment of uncertainty.

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[3] On opinion polarization cf. Sunstein (2003). The 'spiral of silence' (Noelle-Neumann 1984) is a frequently observed phenomenon by which those who perceive their own as a minority opinion hesitate to publicly express it, causing its disappearance.

[4] The very issue-definition has an intrinsic manipulative potential, implicitly circumscribing what is to be regarded as relevant expertise and information and a sensible answer to the policy question. One thing, for example, is to talk of waste disposal or recycling; another of waste production. One thing is to reflect on the most suitable site for an incinerator; another is to reflect on whether an incinerator is actually needed.

[5] A written commitment signed by a political sponsor, as sometimes happens, has hardly any legal relevance: in modern democracies political representation cannot formally take the shape of a principal-agent relationship.

Role of Scientific Expertise

The typical structure of a deliberative arena on environmental issues – apart from organizers and facilitators – includes three categories of participants. One may participate as a 'stakeholder', that is someone provided with a personal and direct interest in the issue at stake (for example, an entrepreneur, a property owner, a member of a local group); as a 'citizen', that is someone involved as a member of the relevant community; as an 'expert', that is someone provided with professional competence and insight.[6]

The role assigned to experts is a clue to the different ways of conceiving deliberation. In the scenario workshop they represent a group among the others, provided with their own views and concerns rather than superior cognitive equipment. As a consequence, members of the different groups mix up when a concrete proposal has to be carved out, in the last phase of the process. Yet this is the exception rather than the rule. Deliberative polls, 'jury' models and most other types of deliberative processes treat experts as the cognitive interface of the deliberating group. A sharp distinction is made, in other words, between cognitive and normative capacities, between those who know and talk of objective things and those who can just talk of interest and value commitments. Experts provide information and answer the participants' questions about facts and data. In environmental controversies they are therefore assumed to have privileged access to evidence about nature, setting the frame for the discussion of cognitively disabled people.

The clash between different views of the social contract of science becomes here especially salient. Those who adopt a business as usual approach or follow the line of a neat distinction between risk assessment and risk management, or political and policy options – that is those who consign risk to objective evaluation and restrict uncertainty to the traditional social realm of value and interest conflicts – find perfectly sound the expert-lay divide in deliberative arenas. Scientific uncertainty does not necessarily affect such divide. To the extent that it is depicted as transitory and deemed to be fixed thanks to additional insight, investment and time, it may indeed enhance the role of experts (Zehr 2000), as the only entitled to set the borders of knowledge relevant to the issues at stake. A convenient diversification of expertise is usually ensured in order to avoid possible biases due to the experts' own political or ethical commitments – sometimes participants can even choose among a pool of experts those whom they trust most. In this way scientists' disagreement is depicted as marginal to the building of a robust cognitive frame. Once the influence of their own value judgements is neutralized by ensuring a balanced variety of viewpoints, the provision of a plurality of expert views adds to, rather than detract from, the solidity of the factual background which the debate has to draw on.

[6] Sometimes one should rather talk of 'key informant', that is a non-professional provided with relevant information, often about particular commitments or positions vis-à-vis the issue at stake – for example, the 'viewpoint of farmers' on the location of a waste repository.

The expert-lay participants divide is of course contested by those who make a case for the subtle intertwining of matters of fact and matters of concern, ways to represent the world and ways to live in the world. Especially according to an inquiry-oriented approach to deliberation, an a priori distinction between cognitively able and disabled actors can prove misleading. As shown by many studies, anecdotal, synthetic, contextual lay and local knowledge can be no less relevant than the general and abstract knowledge of professional experts (Irwin 1995). Moreover, experimental data may be evaluated in different ways by expert themselves. Assessments are always somewhat biased – from a scientific, rather than merely an ethical or political viewpoint. 'As evidence builds we update our degree of certainty of harm, but at any point in time that updated degree of certainty also depends on how suspicious we were initially' (Neutra et al. 2002a: 56). For example, if we assume that only high energy radiations may have biological effects, before questioning such belief we will need a strong evidence of harm associated with exposition to low energy radiations. Another type of bias comes from the context of scientific inquiry. It has been noticed, for example, that corporate-supported clinical medical trials tend to provide new therapies with more favorable evaluations than publicly funded ones. This not so much because of corruption, but because 'a close and remunerative collaboration with a company creates goodwill [that] can subtly influence scientific judgement in ways that may be difficult to discern' (Angell 2000: 1517). As noticed long ago by the epidemiologist Bradford-Hill (1965), what counts as sufficient evidence is linked to the perceived costs of being wrong and their expected distribution.[7]

This sort of considerations lead critics of the DCS on knowledge production to complain that most deliberative designs reproduce the traditional divide between social abilities and disabilities, with experts assumed to deal with factual evidence and public concerns characterized as purely ethical, devoid of cognitive content (Wynne 2001). An UK's major experiment in public consultation, the *GM Nation?* debate on the commercial growing of GM crops, may be regarded as a case in point. Commentators on the critical side have pointed out, as its core features, the engagement of 'innocent' citizens (rather than 'activists', that is people provided with their own views), a focus on consensus and trust building (rather than on the reasons for dissent and mistrust) and a sharp distinction between expert and lay opinions. According to Irwin (2006: 316–317), 'in giving the appearance of democracy, such talk actually diverts from a more adequate onslaught on deeper institutional and epistemic commitments […]. Little has changed: we are simply in the old nexus of technocratic aspirations with the public construed as an obstacle to progress'.

[7] Bradford-Hill provides three examples: 'relatively slight evidence' is enough for a ban on the sale of a widely used drug for early-morning sickness in pregnant women; 'fair evidence' is required to reduce occupational hazards such as change from a probably carcinogenic to a non-carcinogenic oil; 'very strong evidence' is needed for public restrictions on smoking or diets.

Game Configuration

From the viewpoint of the ill-tractability of many environmental controversies, the main asset of DD should be its capacity to increase the legitimacy and applicability of policy choices. The extent to which this is to be expected, however, depends on the configuration of the deliberative game. If the stakes look fixed and the parties believe they can just think of themselves, then strategic behavior is the obvious choice and the game takes a distributive configuration. If the participants think that the stakes can be broadened and that in order to fulfill their goals they need each other, then sincerity may become an asset, the game may take an integrative configuration and the creative search for shareable choices becomes a meaningful effort (Fisher et al. 1991). Distributive configurations, however, are logically dominant on integrative ones, because giving up strategic behavior entails for any actor to see the game as integrative and to be confident that the others share this view. In theory, therefore, the usable space for deliberation – if the latter is to be something more than mere bargaining – is rather narrow.[8] In practice, the game configuration is likely to be affected by several factors.

One of them is where deliberative arenas find their place in the policy process. The closer deliberation is (felt to be) to the decision-making, the more the participants are likely to endorse a distributive configuration. There is some empirical evidence of this (Pellizzoni 2003). Experimental studies in psychology also indicate that cognitive closure is fostered by perception of bio-physical threat (Pantaleo and Wicklund 2000). Being asked to confront opinions or take decisions makes a big difference in this respect, even though the presence of fiduciary relationships may help reduce the recourse to strategic behavior.

The way an issue is framed is of course also likely to be relevant to the perception of the deliberative game as distributive or integrative. The threshold between private and public aspects is a major point in this respect. Some participants may see the allocation of a resource (the control of a good, the power to decide on something) as out of discussion – their own business – while others may regard it as part of the problem. As already noticed, one thing is to reflect on the most suitable site for an incinerator; another is to reflect on whether an incinerator is actually needed. 'Responsible' corporations often welcome stakeholder advice on ecological initiatives, yet they are hardly willing to discuss on how much of their profit is to be spent on environmental protection.

'Focal points' (Sugden 1995) – that is salient features of the issue at stake that anyone involved is able to grasp and agree upon beforehand – are relevant as well

[8] This, at least, if one adopts a rational choice approach to human behavior, that is if one assumes that selfish motivations are the only, or the dominant, ones. Such presumption is obviously debatable (Elster 1995; Heath 2001). However, since the presence of actors all of which provided with a selfish initial attitude represents a worst-case scenario for a 'proper' deliberation, I think that rational choice assumptions offer a good starting point for reflecting on the conditions of possibility of different deliberative configurations, including those which contradict such assumptions.

to the game configuration. This often depends on how the agenda is set. For example, in some circumstances a flexible perspective may foster an integrative configuration; the opposite applies if the effects of a decision look permanent. Not by chance are unwelcome technologies often presented as transitory solutions – pending safer or cleaner ones. Of particular interest is the so-called ‘crowding-out’ effect, that is the dominance of extrinsic, monetizable motivations over intrinsic, non-monetizable ones. Research (Frey 1997) shows that talking of monetary compensations – for example, for an hazardous plant or for the individual contribution to a collective good such as urban waste collection – leads to a distributive configuration. People are encouraged to reflect on how public and private benefits can be accommodated, rather than how the public interest may be fulfilled.

If valuable insight is already available into the factors impinging on the game configuration and on the consequent room for a ‘proper’ deliberation, further research is needed to provide a more robust, detailed picture. This applies especially to the role of cognitive uncertainty. It is unclear on what terms deep forms of uncertainty like those related to many environmental issues – think for example of adaptive measures to the rising level of seas, as a possible consequence of climate change – may lead to a distributive configuration, with the parties stuck to their position and using the available evidence in a strategic way, rather than to an integrative configuration, the open mindset of the parties allegedly depending in such case on their being unsure about the policies best suited to ill-defined interests.[9]

Institutionalized Biases in the Treatment of Uncertainty

Uncertainty is of major relevance also from another viewpoint: the existence of institutionalized biases with regard to its treatment. If any non trivial environmental issue is confronted with significant levels of uncertainty, in deciding what to do one can make two types of errors: false positives (Type I errors, as statisticians call them) and false negatives (Type II errors). ‘False positives occur when an initial finding of (unacceptable) harm later turns out to have been incorrect. False positives are risked by presuming “guilty until proven innocent”. […] False negatives occur when an initial finding of no (or acceptable) harm later turns out to have been incorrect. False negatives are risked by presuming “innocent until proven guilty” (Wiener and Rogers 2002: 321). We can reduce the probability of Type I errors (for example we take as true that some GMO has harmful environmental effects while, as we later clarify, this actually is not the case) only at the cost of increasing the probability of Type II errors (we reject the hypothesis that such GMO is harmful

[9] The latter case corresponds to Rawls’s (1971) well-known mental experiment about the ‘veil of ignorance’. According to him, insufficient information about one’s own future position in society (class, social status, access to natural assets and possession of abilities etc.) leads to the search for equitable distributive rules.

while, as we later ascertain, this is actually true), and the choice of different levels of significance for these errors (that is different burdens of proof) is conventional (Stewart 2000). It therefore depends on assumptions about the relevance of one or the other error, usually related to some notion of what is good and desirable. If, for example, we are concerned with the increase in environmental degradation we will likely lean towards reducing false negatives in experimental (and judicial) trials; if we are instead concerned with an over-restrictive regulatory system we will lean towards reducing false positives.

Beyond the statistical lexicon, the point is that in taking decisions we may incur two different types of mistakes: rejecting something that we should have accepted or vice versa. These possibilities cannot be reduced at the same time, and there are no objective criteria for balancing them. The controversy over precaution, in this sense, can be traced back to a contrast between those who are more concerned with false positives, because they believe that being too worried about uncertainty entails 'financial losses, restricted freedoms, and the foregone health and environmental benefits of restricted technologies' (Wiener and Rogers 2002: 321), and those who are more concerned with false negatives, because they believe that current regulatory arrangements are insensitive to many environmental threats. While the former stress that sensible policy-making requires evidence of harm, the latter contend that no evidence of harm is not the same as evidence of no harm, since it may depend on insufficient or unsuitably designed research.

It is important to remark that these orientations are not so much a matter of individual preferences, as of institutionalized roles. For example, it is logical for entrepreneurs to be more concerned with Type I errors because the latter impinge on the profitability of investments, prompting them to address fictitious problems, as would be the case if they had to rearrange electric power lines in response to misleading epidemiological or experimental evidence of harm caused by electromagnetic fields. False positives are also usually of greater concern for scientists. To mistakenly find out something that does not actually exist may hamper research progress, while if something that really exists has not been detected yet, it can still be captured by further inquiry (Cranor 1993). Consequently, methodologies are often designed to reduce false positives at the cost of increasing false negatives. Think for example of the stress of experimental studies on exposure to single agents or conditions rather than mixtures, even though many biological effects have an obvious multi-causal nature. On the other hand, when research is used for environment protection purposes the implications of false negatives are more important than missing or slowing down innovation. This is the typical viewpoint of environment and health agencies or technology end users and local communities. Approaches to uncertainty, thus, have their own political constituencies (Hammond 1996) and cycles of policy adjustments may be observed as a consequence, as with the European and American oscillations in the application of precautionary policies (Pellizzoni 2009a).

Biases in the treatment of uncertainty are also embedded in specific scientific disciplines. This helps explain why, as already remarked, scientists may assess a same evidence in different ways. It is probably not by chance that geneticists and molecular biologists are overrepresented among those who stress the benefits of GMOs, while ecologists, biologists of populations, agronomists are overrepresented among those who stress their potential risks. The former are used to think in terms of direct cause-effect relations; the others in terms of complex, ill-controllable interactions. Similarly, being used to think of human history in terms of scarcity overcome through innovation, economists are often more optimistic than ecologists about technological answers to environmental problems (Sarewitz 2004). Biases in the treatment of uncertainty are also a matter of policy frameworks. The social justice framework typically adopted by NIMBY groups leads them to focus on false negatives and justify expensive policies 'on the basis of a few credible scientists suspecting a small risk that violates the rights of even a small group of people', whereas economists, engineers and regulatory agencies usually focus on false positives because they follow an utilitarian approach, searching for the option 'that aims at producing "the most good for the most people at the least cost"' (Neutra et al. 2002b: 2).

To sum up, a typical problem of deliberative arenas is that they gather people provided with different orientations about uncertainty. This may obviously undermine the joint search for, and assessment of, policy options, leading to diffidence and distrust and to a distributive game configuration. Though systematic research is needed in this respect, a connection is to be expected in most cases between inclusiveness of an arena and number of participants with no direct access to the benefits of a policy, with consequent attention to its distributive trade offs and prevalent concern for Type II errors. Similarly, since a false negative can be read as an externality (in the sense that the effects of decisions are different from, or additional to, those foreseen and included in the deliberators' window of concern), it is reasonable to expect that the broader is the agenda – and especially the greater is the attention to externalities – the stronger will be the focus on Type II errors.

On the other side, those who are more concerned with Type I errors are likely to find more sensible a tightening of the scope of inclusion, or of the agenda, or both. This finds support in a widespread prejudice adverse to assigning regulatory and policy priority to false negatives (Freudenburg et al. 2008), as a consequence of cultural biases and organized interests pressures in favor of innovation and growth. Since the advantages of the latter are assumed to be unquestioned and generalized, so its unforeseen costs have to be. Such costs cannot be borne by the innovator because they may exceed any budgetary preventive measure, deterring advancement. If 'technological innovation has given rise to increasingly complicated product design and manufacturing processes, the long-term effects of which cannot be foreseen with certainty' (European Commission 1999: 22), even the damaged citizens ultimately benefit from innovation. Examples of this approach can be found in the Directive 85/374/EEC on product liability and the Directive 2004/35/CE on environmental liability. Producers and operators are not held liable if they show that, according to scientific and technical knowledge at the relevant time (commercialization of a product, emission release, etc.), they had no possibility to detect problems. This prejudice favorable to growth and innovation not only leads policymakers, companies and scientists to frequently downplaying Type II errors – with consequent dismissal of early warnings and regulatory failures, as with asbestos, BSE and many other cases (EEA 2001) – but also to take environment and health issues as a matter of risk reduction, whereas the public may be more concerned with the broader impacts and justifications of innovation (Felt and Wynne 2007). The likely result is a dialog of the deaf, and policy decisions affected by what is sometimes called 'Type III errors' (Schwartz and Carpenter 1999): providing sound answers to the wrong questions. Institutionalized biases in the treatment of uncertainty represent therefore a constant threat to the application and fruitfulness of deliberative processes.

Conclusion

Promises and perils, strengths and weaknesses of DD are extensively discussed. Drawing on a fast developing literature in political theory, environmental sociology and sociology of scientific knowledge I have reflected on why public deliberation has been often applied to environmental questions and what are the basic challenges it encounters in this field. The attractiveness of deliberative arenas can be explained in the light of the legitimacy crisis of traditional policy processes; a crisis where the saliency of uncertainty plays a major role and which brings into question the dominant division of labor on the production and application of environmental knowledge. DD represents a participatory, inclusive reply to this crisis, yet in many cases its actual import is debatable. The possibility of 'proper' deliberations, that is something more than mere negotiations, is limited by many factors. There are systematic mismatches in the way those who gather round a deliberating table address uncertainty. There are strong motivations to hold as much as possible the traditional divide in knowledge production, affecting the design and practice of deliberative processes.

Radical criticisms of the DCS focus precisely on deconstructing the boundaries between production and policy application of knowledge by showing how uncertainty makes such boundaries increasingly debatable, the search for facts and truths being mixed up with normative commitments that cannot anymore be disclaimed or taken for granted. The assumption here is that, if the production of knowledge is increasingly crucial to politics and economy, then 'democratizing' the former will crucially help democratize the latter. The task then is to remove strong yet well identified obstacles to truly equitable deliberations; to overcome those forces that, by defending the existing cognitive order, protect a social order affected by unacceptable privileges and inequalities.

Yet one should reflect carefully on the implications of the growing saliency of uncertainty. As regards climate change, for example, the lack of unquestioned certainties, the inevitable scientific discords, have been used in the policy arena as arguments for shelving or postponing stricter measures (Freudenburg et al. 2008). More in general, one should reflect on the possible effects of dismantling the institutionalized separation between production and policy uses of knowledge. Its breakdown might lead to decreased, rather than increased, openness to public scrutiny. Exposing to debate and negotiation any cognitive standpoint may undermine, rather than strengthen, 'weaker' interests and insights. The more is knowledge maintained to be positional, the less distinguishable is it from power and, consequently, the more is power able to label any form of knowledge-based dissent as a minority partisan stance – to be conveniently dismissed according to the rules of democracy (deliberative arenas included) or of the market. Such drift is already noticeable in the bioscience field, where what was once regarded as a non-proprietary discovery is increasingly described as a patentable invention. The result is not an expansion of the public review of innovation, but of the private appropriation of the biophysical world (Pellizzoni 2009b).

Not by chance some scholar has begun to express concern for the use of scientific uncertainty or of the narrative of the manufactured character of things as a weapon in the struggle for power and money (Latour 2004). The scope of deliberative arenas may therefore be undermined not only by persistent appeals to hard facts as the preserve of qualified actors but also, and perhaps above all, by the broadening acknowledgement of the manufactured, proprietary character of biological matters. Public scrutiny of knowledge production may decline not so much because it is beyond cognitive reach, but because it is beyond legal reach.

Deliberative democracy can hardly represent by itself an answer to these problems. Its potentialities may flourish not only as a result of procedural refinements, but of broader social reforms. Something is moving in this respect. For example the idea of 'public domain' (Boyle 2003), as a space encompassing intellectual goods on which no proprietary rights can be exerted, is of major relevance and its applications (mostly in the ICT field) promising. Prospects for a 'democratization' of knowledge production and use are however uncertain, being confronted with powerful political, economic and scientific interests and ideologies, for which the defense of the traditional narrative of science and politics is premised on the pursuit of their own goals and visions of society. In this sense the conditions of success of deliberative democracy in the environmental field cannot be measured only in terms of intellectual elaboration and practical experience, as in terms of emergence of social forces capable to impart a major swing to the current tangle of techno-science and neo-liberal political economy.

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Part III
Transdisciplinarity and Sustainable Development

Chapter 11
Knowledge and Social Learning for Sustainable Development

Bernd Siebenhüner and Harald Heinrichs

Abstract Building on the on-going discussion about topical knowledge, social learning and sustainable development, this article discusses the problem horizon of non-sustainable development in order to highlight the necessity of social learning processes and to discuss the relevant conceptual approaches to social learning. It is argued that in order to meet the challenges of global environmental changes, social learning based on scientific and practical knowledge is essential. The article ends with a review of methods and procedures of initiating social learning in social practice.

Keywords Social learning • Resonance capability • Sustainability • Society–environment interactions • Reflexivity

Introduction: The Sustainability Challenge and the Need for Social Learning

The beginning of the 1990s: The Cold War is over and the conflict between the two great political and economic ideologies seems – for the moment – to be decided too. As market economies and democracy appear the inevitable victors, American social scientists euphorically declare "the end of history" (Fukuyama 1992). In this period of exceptional international upheaval, global environmental and development problems, which during the geopolitical power game in the post-war period had played a subordinate role, became global hot topics. Influenced by these historical

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conditions, 178 nations pledged to adopt the so-called Agenda 21 at the world environmental conference in Rio. Building on work done by commissions and researchers in the late 1980s, the document was a draft for future global development in which economic growth, social justice and ecological stability were to be closely linked (Bandura 1977; World Commission on Environment and Development 1987). The 'grand idea' of sustainable development, which was the outcome of contributions by numerous academic, political and civil society actors, triggered a number of initiatives worldwide: at local, national, regional and international levels as well as in a variety of different social spheres such as politics, science, economics, and society. Over the last decade, sustainability has without doubt become a major socio-political topic.

So far, however, the sustainability debate remained an elite discourse among professionals and experts that hardly catches the attention of the broader public. In addition, the exact meaning of sustainable development is still subject to intense debate and interpretation. Its normative thrust is still highly contested (Brand 1997). It is thus not a coherent, explicit future program supported by all actors, but more of a reference point for varying interpretations based on heterogeneous interests, values and knowledge claims entered into the (expert) public discourse. 'Sustainable development' as a broad based vision of the future as projected by international politics onto the world agenda must be spelled out in social (self) understanding processes and concretized in order to substantially change action routines. Societies, as well as the global society, must collectively learn to engage in anticipatory decision-making in order to realize a sustainable development of socio-economic systems that maintain our natural conditions of life in the long term.

Along with political control mechanisms and economic stimulus instruments, which themselves are the result of political learning (Sabatier 1987, 1988), informative-educational and communicative approaches for the promotion of sustainable development have gained in importance in the past few years. These approaches include the interactive development of political processes through citizen participation and stakeholder cooperation, formal and informal activities as a part of education for sustainable development, as well as trans-disciplinary research and development projects uniting science and practice. Also the perspective of informational environmental governance (Mol 2006), which emphasizes the importance of environmental information in the greatest variety of forms (labels, websites, media) for social self-regulation, is directed at individual and collective learning processes that should lead to modified behavioral patterns. Due to the physical and social complexity of global environmental changes, in which there is an interplay of elaborate biophysical causal relationships with a variety of social actors, as well as the projected wide-ranging consequences and changes, intentional, sustainability-oriented, social learning – in addition to the continuously occurring 'accidental' learning – seems to have become a *conditio sine qua non*. Building on the on-going discussion about topical knowledge, social learning and sustainable development, in this article we would like to contribute to the conceptual establishment of this research and action field. First of all, we delimit the problem horizon of non-sustainable development in order to highlight the necessity of social learning processes and use past environmental problems to sketch out the principle ability for social learning. We argue that in order to meet the challenges of global environmental changes, social learning based on scientific and practical knowledge is essential. The major part of the article is to discuss the relevant conceptual approaches to social learning. Finally we end with a review of methods and procedures of initiating social learning in social practice.

Diagnosis: Dynamics and Interferences in Social–Environmental Interaction

Humans interact with the material world in order to satisfy their needs. As biological creatures we are a part of ‘nature’ and need the bio-physical environment mainly to maintain basic life functions (metabolism). The development of cognition in human history has given us a greater degree of freedom vis-à-vis ‘nature’: Creativity and the expansion of technical skills has immensely increased the reach of social use of the environment and its development. Indeed the power of scientific-technical innovation has dramatically increased the possibilities of human thought and action over the course of the last 200 years. The following graphic gives an impression of the enormous dynamic of environmentally-relevant, industrial production and consumption (Figs. 11.1 and 11.2).

The material progress shown in these figures has not been without consequences for the natural conditions of life. Currently every day about 60 million tons CO_2, 200,000 t of fish are caught, 50,000 ha of forest are destroyed, as many as 100 species are annihilated, and 20,000 ha of farmland are converted and degraded.[1] If the statistical data is aggregated at a global level over time then the dimensions of environmental change since the industrial revolution become more visible, as illustrated in the following time series by Steffen et al. 2004.

Without doubt “constructions” of such highly aggregated data must be critically examined. It is however clear that for the dynamics in the ‘social’ and ‘environmental’ systems material and social progress and global environmental changes are closely intertwined. At the same time, environmental opportunities and risks, costs (environmental and social problems) and benefits (mass consumption) are distributed, from an intra- and inter-generational or an intra- and inter-national point of view, extremely unequally: (World) political development is characterized by socio-economic inequality and an associated asymmetrical distribution of power (Beck 2002; Heinrichs et al. 2004).

In a retrospective analysis, as well as in an analysis of the present, empirically observed disturbances to the society-environment interaction are seen as unexpected, surprising side effects and long-term effects of human action affecting the environment. Moreover, since the study ‘Limits to Growth’ of 1972 ‘anticipated

[1] www.oecd.de; www.uba.de

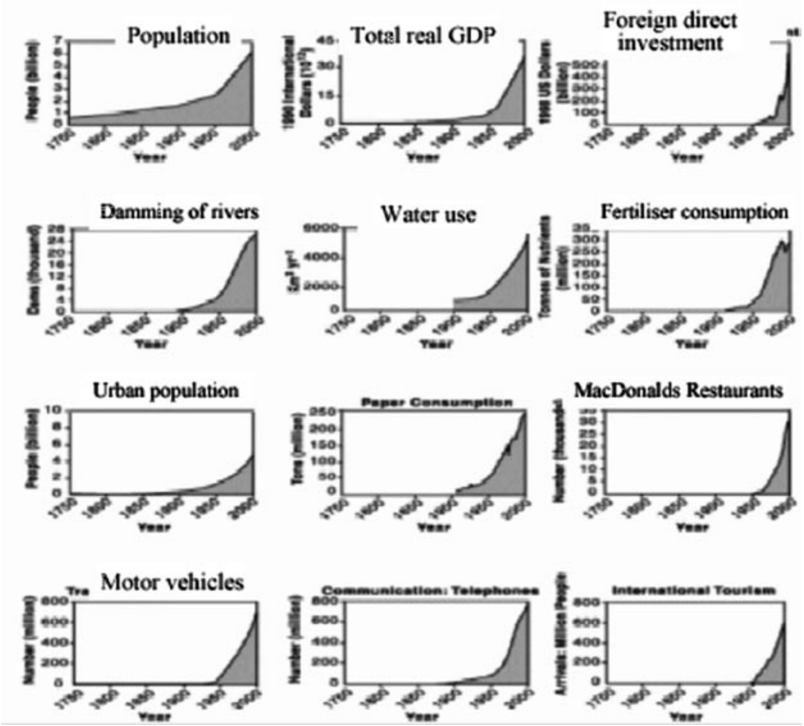

Fig. 11.1 Dynamics in the social "system" (Steffen et al. 2004)

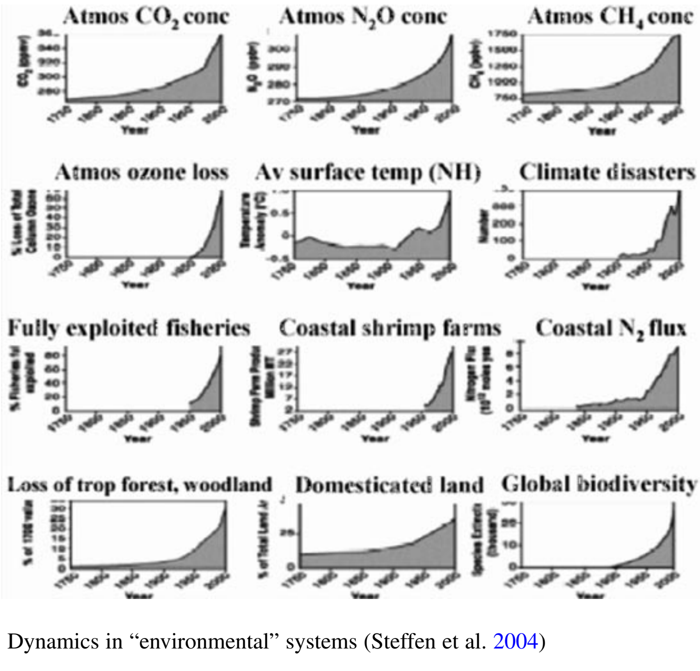

Fig. 11.2 Dynamics in "environmental" systems (Steffen et al. 2004)

disturbances' such as global climate change created in computer-supported modeling and simulations have become socially relevant (Meadows et al. 1972).[2] The history of past disturbances, such as urban air pollution at the beginning of the nineteenth century, as well as of anticipated disturbances, such as global climate change, point toward the dynamic of the relationship between societies and their material environment. That societies are in principle able to learn is shown by a cursory look at the environmental history of the twentieth century.

Social Resonance Capability: Reflexivity and Social Learning

Environmental history shows how anthropogenic environmental changes themselves have feedback effects. It shows also however that and how humans themselves have reacted in turn to environmental problems (McNeill 2003). Since humans do not have, in an epistemological sense, immediate access to the world, or environment, and instead must perceive, evaluate and interpret phenomena both cognitively and emotionally in a mediated fashion, societies can react to changes in the environment in very different ways; this has been demonstrated especially in social constructionist studies (Hannigan 1995). Regulation of the society-environment interaction ranges from traditional, ritualized forms of interaction with public goods, such as for example mountain pasture usage or close seasons for hunting, from the discovery of sewage systems or waste disposal to international environmental accords. Since 1970 propelled by environmental movements, media reporting and scientific studies, governmental environmental policy has been institutionalized on an (inter)national level, and has systematically tackled environmental problems and achieved relevant successes. The broad-based civil society and political establishment of the environmental topic in a number of action levels from local to global is an impressive example for the resonance and problem-solving ability of society. In this process the instruments for regulating the environment-society interaction have been – reflexively – refined and diversified (Knaus and Renn 1998).

Initially the regulative instruments dominated environmental policy: commands and prohibitions, directives and binding court decisions create norms and standards for all citizens. The legal framework is supposed to control individual and societal environmental actions. In the 1970s hierarchical control instruments were the preferred means of regulating the most urgent and greatest environmental problems. In the 1980s – even under the influence of neo-liberal macro-trends – stimulus-oriented instruments became more important. The goal was to use the price mechanism to achieve a dynamic, economically efficient and flexible behavioral control. These mechanisms were accompanied by informative-educational measures to enhance environmental consciousness and show opportunities to act in an environmentally sound way. Many urgent environmental problems of modern society could be, if not solved, at least tackled by these approaches: The spectrum

[2] http://www.ipcc.ch/

ranged from improving water quality in major rivers and the general quality of the air to decoupling economic growth from energy consumption. Despite improvements of manifest environmental problems, especially in the western industrial nations, persistent, obscure environmental risks, which are closely related to social and economic conflict potential, are still unsolved at a global level. In the face of the enormous material and social complexity of non-sustainable development dynamics, the limits of governmental social control became apparent.

Alongside this hierarchical understanding there emerged one that involved greater cooperation between government and society. Descriptions such as ‘arguing state’, ‘moderating state’, ‘participative democracy’, ‘discursive policy-making’ and not least the discussion about ‘governance’ supplementing ‘government’ all point in the same direction: A stronger coordination of governmental and non-governmental actors is considered necessary in order to optimize political control and societal self-regulation (Mayntz and Scharpf 1995; Werle and Schimank 2000). In the past three decades deliberative elements in environmental policy have become more and more important, although already in the 1970s in Germany, alongside the polluter-pays and the precautionary principle, the cooperation principle was a guide to action and in the USA at this time alternative conflict regulation procedures such as mediation were established. The goal of sustainable development meant that dialog-based communication, participation and cooperation approaches gained clearly in relevance. The focus was on, first, the attempt to create a structured two-way communication; second, that conflicting arguments and claims should be referred to each other so that a consensus could be reached even about dissent; and, third, that in advisory processes solutions to problems could be jointly developed by heterogeneous actors. According to Grunwald (2002), six goals are essential for target-oriented information seeking, learning and development processes:

– Dispersion of knowledge necessary for decision-making (supplementing scientific expertise with local knowledge/experiential knowledge/professional knowledge)
– Dispersion of values needed in order to increase the social robustness of decisions
– Information function in order to allow individuals to make informed evaluations
– Increasing social compatibility by consideration and reflection of differing claims
– Conflict avoidance and resolution by the cooperative search for jointly supported, objective solutions
– Orientation to the common good, as rational discourse overcomes particular self-interests

A special challenge in connection with sustainable development processes is how interdependent and time-space distanced effects are dealt with: The long-term orientation of sustainability is characterized by diagnosis uncertainty and limits to knowledge, including forecasts, risks, simulations and scenario, but also in regard to future interests and values. Knowledge pluralism, as a variety of authors have pointed out, is therefore crucial for sustainability learning (e.g., Gibbons et al. 1994;

Nowotny, 2001). On the one hand scientific knowledge as a key element in pluralistic knowledge societies is essential to the analysis and further development of sustainable development, as more and more areas of society are dependent on systematic knowledge to solve problems; at the same time however the uncertainty and contingency of knowledge claims is growing. Along with disciplinary differentiation and segmentation, inter- and trans-disciplinary knowledge production oriented to meeting practical challenges in sustainability has as a result gained in relevance (Gibbons et al. 1994). Furthermore, other forms of knowledge, such as professional practical knowledge or cultural everyday knowledge are being considered relevant for societal development processes (e.g., Stehr 1994; Krimsky 1984). The heterogeneity of social groups and actors, each with its own interpretation of reality, creates a challenge for a socially robust production of knowledge, learning and decision processes (Nowotny 2001). The limitations of scientific expert knowledge—though doubtlessly essential—and the limits of technocratic controls for processing (non) sustainable developments requires discursive search and learning processes. In the following, key concepts regarding social learning will be discussed in order to more systematically understand the opportunities and limits to intentional learning processes for sustainable transformation processes.

Conceptualizing Sustainable Social Learning

Social learning has many different connotations and meanings in a number of contexts and disciplinary perspectives. It is the objective of this section to sketch different conceptual approaches to social learning that seem relevant for a transition towards sustainable development.

In *social psychology*, the predominant focus has been put on individual learning whereas social learning has raised the attention of social psychologists only rather recently. One crucial contribution to the study of social learning phenomena by psychologists has been the approach developed by Bandura. He published his social learning theory in 1977 which built on behaviorist foundations. In his understanding, social learning is an individual learning process that is triggered through social contexts such as other people, social situations and institutions. He examined learning effects that are based on observing and imitating the behavior of others or on the cognitive reflection of social events and experiences. Therefore, Bandura's social learning theory has a distinct focus on social learning that does not address learning processes of larger collective entities such as organizations or even societies. The approach, however, gives an idea of when and how certain behavioral patterns diffuse among social groups. His model maintains that individuals copy or attempt to copy those kinds of behaviors that they observe to have positive consequences for the actors. In this process of imitation their learning depends on the given circumstances due to selective perception, their motivation to learn, and their capacity to capture and memorize the elements of this behavior.

Starting out from a similar notion of social learning, Goldstein (1981) focuses on the cognitive as well as value-related aspects of it. He views social learning as "a higher form of learning occurring in a social context for the purpose of personal and social adaptation" and restricts the social context to situations of interpersonal relationships. In general, social learning is, in his concept, a goal-directed experience which individuals embark on when they attribute meaning to the objects of learning. Social learning always involves an affective and a moral dimension since it implies the experience of new or reversed values. Therefore, it often leads to individual or collective disruption because it disturbs the traditional balance of value structures inside the individual. He finds that the diffusion of new behavioral patterns and thus social learning within larger social entities occurs when the innovators are numerous, prestigious and somehow respected characters. The situation has to be prepared for the social learning events by being open towards new behaviors providing the necessary resources, information, and support. For the questions of sustainable development, one could conclude that large scale changes in patterns of behavior and social learning in general imply normative and affective dimensions and necessitate a critical mass of individuals who buy into these behavioral innovations to induce learning processes with others.

Concepts of *organizational learning*—also named as "the learning organization"—have been developed in management studies to describe processes of organizational change that take place at a collective level.[3] In this body of literature the distinction between individual and collective action is crucial—in particular for the choice of the appropriate theoretical and analytical approach. It is commonly assumed in this literature that organizations exist on the basis of collective action. According to Argyris and Schön (1996), it is the precondition of collective action that the individual member "must (1) devise agreed-upon procedures for making decisions in the name of the collectivity, (2) delegate to individuals the authority to act for the collectivity, and (3) set boundaries between the collectivity and the rest of the world." These requirements pertain to a number of social actors and collectivities such as non-governmental organizations, neighborhood councils, scientific bodies and associations, and certainly companies.

Based on these considerations, questions remain concerning the relationship between individuals and the collectivity and the relatedness of their learning processes. Although the notion of collective learning implies that it is more than the mere sum of individual learning by its members, it is dependent on individuals, their learning and their behavioral changes. In this line of thought, collective learning can be seen as the change of procedures, structures, shared beliefs and knowledge that are assembled from individual contributions. For instance, the knowledge how to produce cars, telephones or computers is inherent to the relevant organization but individuals usually oversee only a small part of the whole production process. In this sense, division of labor in an organization allows for the possibility of collective learning.

[3] For overviews on this literature see Dodgson (1993); Argyris and Schön (1996); Dierkes et al. (2001).

Another argument comes from systems theory, which regards organizations as entities by themselves that are more than the sum of their individuals. In this view, organizational learning is mostly studied on the basis of analogies to individual learning. Probst and Büchel (1997) define organizational learning as "the process by which the organization's knowledge and value base changes, leading to improved problem-solving ability and capacity for action." This perspective treats the organization as a unitary actor. It also maintains that social learning encompasses a dimension of changes in values, norms and beliefs that transcend the sphere of pure cognitive knowledge. Therefore, simple training of cognitive skills or technological improvements might be helpful but it hardly suffices to tackle the deeper dimensions of commonly shared values, norms and general convictions.

Economists increasingly analyze learning processes on the level of individuals following severe criticism of the assumptions of the rational-actor paradigm. While until recently, most economists stuck to the idea that the individual's information about future consequences of all available alternatives to be complete, there is no need for any kind of learning. More recent approaches, however, such as Simon's (1982, 1986) concept of bounded rationality or the rational-expectations theory, start out from the assumption of given uncertainties which gives way for learning processes in individuals.[4]

By far the most prominent approach is Bayesian learning stating that rational individuals will consider all available information in their utility-maximizing decision process. They have to run virtual computer programs in their minds in order to process the information from past decisions and the likelihood of the respective futures. However, this normative model has a questionable empirical basis since it has never been subjected to empirical testing and rather serves as a normative statement (Brenner 1999).

In recent years, several new approaches have emerged to model learning processes in economics, most of them referring to individuals. Prominent approaches discussed here comprise adaptive learning theory which assumes individuals to constantly improve their internal model of the real world (Sargent 1993) and classifier systems examining routines and rules of thumb in learning and decision making (Goldberg 1989).

A growing number of economists also address issues of social learning which is defined rather broadly as occurring "in any situation in which agents learn by observing the behavior of others" (Gale 1996). This notion follows Bandura's phrasing of social learning by focusing on individuals as the central agents of learning. However, there are also approaches to be found that address learning processes on a population level or in social networks. For instance, evolutionary algorithms use the paradigm of genetic selection to model learning processes within populations over time (Goldberg 1989). The neuronal network approach, by contrast, builds on the idea that learning processes take place in some network

[4] For an overview over the economic approaches to learning see Kirman and Salmon 1995; Brenner 1999; Slembeck 1999.

structure for the processing of information. These networks could be modeled within individuals as well as within groups or social networks (Salmon 1995). Another currently discussed topic of social learning theory in economics is herd behavior and informational cascades. These are instances when individuals ignore the private information and subjective probabilities they usually employ and follow the behavior of others whom they assume to be better informed than they are. These models have been used to explain mass panics, social customs, and the persistence of inefficiencies in companies although the agents do have better information at their disposal (Gale 1996).

In these models, individuals are considered within their social contexts and the dynamics of social communities are subject to economic investigation which, however, remains largely in the realm of theoretical modeling without empirical testing. It is the strength of the economic approaches to social learning that they apply a modeling perspective and achieve to explain e.g., diffusion processes among social entities. Under the perspective of promoting sustainable development these models can be used to identify learning patterns and necessary communication structures for the diffusion of norms and more sustainable patterns of behavior.

Scholars from *political science* have discovered the field of social learning rather lately. There is an increasing field of concepts and empirical case studies of social learning; however, theories of social learning with respect to sustainability issues are scant. They have been applied to different levels of governance and policy making such as the following:[5]

- *Local arena*: One crucial arena for change in the direction of sustainable development are communities, neighborhoods and initiatives on the local level. Promoting sustainable lifestyles, implementing Local Agenda 21 initiatives, launching community projects, bringing together local actors and reaching out to other communities and regions are challenges and learning tasks for local communities in this respect. In most cases, social learning has been organized in public participation processes. Webler et al. (1995) report on a deliberative process conducted in Switzerland to decide about a waste disposal site. They found significant cognitive and moral developments taking place on the side of the participants in these processes which lead to better informed and consensual decisions. In the sustainable community projects discussed by Smith and Blake (Smith et al. 1999), it has mostly been individuals who triggered learning processes within social groups and the individual participants. They were needed as "catalysts" to new solutions and projects. The action-oriented research effort undertaken by Johnson and Wilson (2000) detected "learning points" in participatory development projects in the different perspectives of the participating actors. Building on a study of the Columbia River Basin water management, Lee (1993) emphasizes the role of trust and confidence in participatory approaches

[5] A meta-analysis of pre-existing approaches on policy learning is included in Bennett and Howlett 1992.

and their sustained solutions: "Learning is a gradual ascent towards confidence punctuated by the slippery panic of disappointments."[6]

- *Domestic politics*: This class of approaches addresses questions like: How do political systems and particularly political decision makers learn? Where does the knowledge come from that is applied and diffused in the learning process? What has been learned? How could the resulting changes be measured? The different concepts in this field vary in their focus on the learning agents. Some focus exclusively on governments such as Etheredge (1981), while others like Heclo (1974) and Sabatier (1987, 1988) additionally examine societal actors such as elite structures, networks, and other social groups as learning agents. The latter approaches stress the role of norms and belief systems in learning processes within a network structure, called "advocacy coalition" by Sabatier.
- *International relations and comparative studies of different countries:* Another group of studies in policy learning address the international arena and investigate whether and how states learn from each other and whether and how international communities are able to learn. Rose (1991, 1994) addresses issues of "lesson-drawing" where one state benefits from the experiences made by other states. The concept of epistemic communities as developed by Haas (1992) and Adler (1992) draws the attention to mostly internationally organized networks that are united by their shared beliefs and convictions about particular political problems and the favorable solutions to them. These networks usually consist of scientists, lobbyists, political decision makers and advocacy groups. Insights on issues of sustainability in the field of learning between countries are to be found in diffusion studies which analyze the spread of (environmental) policy innovations across countries (Jänicke and Jörgens 2000; Tews et al. 2003). These studies identified national pressure groups, public administration and its traditions, and public opinion channeled through the media as key drivers for the acceptance of policy innovations.
- *The global society as a whole*: Many environmental problems such as climate change, ozone depletion and biodiversity loss and health problems such as life-threatening diseases like Malaria, Tuberculosis, HIV/AIDS and others are global threats to the entire human society. Humanity has encountered a number of these problems successfully through forms of collective learning. A number of authors developed conceptual frameworks for the understanding of this kind of global learning. These draw on empirical case studies of particular learning areas such as combating plague, cholera and smallpox (Cooper 1989), implementing Keynesian economic policy (Hall 1989) or managing global environmental change (The Social Learning Group 2001). Key factors for social learning identified in these studies have been innovative ideas mostly brought about by scientific research and engaged individuals or the media who promoted these ideas—be they findings about new kinds of problems or new solutions to old problems.

In the face of this variety of ways to conceptualize social learning in the political realm one should bear in mind that all of them address phenomena where groups or social actors change their behavior on the basis of new knowledge or an alteration

[6] For an overview of related cases of local level social learning processes see Wals (2007).

of the norms and values underlying their behavioral patterns. Therefore, they—in one way or another—provide blueprints for projected social changes towards sustainable development. They identified the key role of leaders or change agents, collective actors or networks as promoters of change, social discourse and scientific information for social learning which can guide pathways for the design of social learning processes for sustainable development.

Resulting Practical Insights

Thus far, these literatures on social learning have identified a number of relevant factors for successful processes of knowledge-based change towards sustainability. They provide useful guidelines for the set up and design of these processes on different geographical and organizational scales and contexts.

Collective learning in organizations such as public authorities, nongovernmental organizations or corporations thus necessitate first and foremost committed individuals that promote the ideas, insights into the problems attached and related solutions. Second, they need structures that facilitate the generation of novel ideas, concepts and that provide sufficient space for developing and advancing innovative solutions to problems of sustainability. These structures can be learning workshops, creative teams, sustainability-oriented research and development procedures, or alike (Siebenhüner and Arnold 2007).

On the level of local communities, villages or neighborhoods, social learning can be advanced through innovative project designs. As the examples assembled in Wals (2007) show, fields for creativity and innovations are needed to develop novel solutions that need to be discussed and communicated in dense local and regional networks involving different stakeholder groups. Community processes need to be tied in to related curricula at kindergartens, schools, universities and institutions of vocational training. However, without political guidance and forceful support for these developments towards sustainability, little advancement will be achieved.

Therefore, political processes on the various levels of political decision making need to become involved in sustainability-related social learning. This relates to substantive and process dimensions. With regard to the substance of sustainability-oriented governance and policy making, political programs, regulations and precise concepts towards more sustainable solutions in various fields of society are essential. This could be sustainable education programs, eco-friendly energy policies, waste management projects, efforts to reduce motorized traffic and alike. In a process dimension, governance processes are called for that are more reflexive and inclusive. Examples include participatory processes that include different stakeholder groups, scientists, and decision makers into consensus building exercises and related decision making. Concepts such as adaptive co-management (Olsson et al. 2004), reflexive governance (Voss et al. 2006) or transition management (Mulder and Biesiot 1998; Smith et al. 2005) provide concepts and empirical examples how to implement sustainability-oriented social learning processes within political processes.

Conclusions

The challenge to change individual and collective habits and behaviors on a large scale in particular in industrialized societies still lies ahead. The insights into the problems of social development, global equity, and ecological sustainability require massive and lasting change in current practices to reduce ecological burdens and to foster more socially just and fair ways of co-existence. However, so far, most of these societies are far away from sustainable solutions on the scale needed to effectively tackling these problems. While several solutions on local and organizational level guide interesting ways how this change could work and look like, the larger scale of the level of societies has hardly been reached in any of the industrialized countries.

This account provides a challenge for almost all actors and stakeholder groups in society. Political decision makers will need to address the problems of sustainability more broadly and more inclusively and with a global perspective. Citizens have to re-consider their consumption behavior and become involved in local and regional communication with others. The institutions of the educational systems have to focus more thoroughly and more systematically on issues of sustainable development in the various subjects and learning contexts. These need to be backed by supportive and activating learning methods. Companies are also key actors on the path towards sustainability. They are required to reconsider and change their core practices and their influence on society and the environment; they are called upon to develop effective solutions to the problems that include technological and organizational innovations. Last but not least, scientists will need to address sustainability problems in the various disciplinary fields by more integrative work that includes the expertise of different disciplines and non-scientific stakeholders. Finally, they will also have to study social learning and knowledge generation towards sustainability to better understand and facilitate these processes in the future.

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Chapter 12
Beyond Neocorporatism? Transdisciplinary Case Studies as a Means for Collaborative Learning in Sustainable Development

Michael Stauffacher

Abstract Stakeholder involvement in political decision processes is sometimes claimed being a corporatist arrangement – generally with a pejorative connotation. Answering this claim, I first review the discussion of neocorporatism. Secondly, I present our own work, the Transdisciplinary Case Study (TdCS). Through this design, we initiate and foster collaborative learning processes in sustainable development. I discuss if the TdCS design can be understood as neocorporatist arrangement. In a literal classical understanding this is not the case. In a broader process understanding, our design resembles a neocorporatist like interest mediation. Yet, it goes well beyond: a larger number of stakeholder groups is involved; the role played by science is emphasized; and it is conceptualized more as learning process than as interest negotiation. I conclude by showing some implications from this macrosociological perspective for our work. I will pay special emphasis to the crucial role(s) science plays.

Keywords Neocorporatism • Sustainable development • Stakeholder involvement • Science and society • Transdisciplinarity

Introduction

Contemporary societies are often confronted with complex decision problems not least with respect to sustainable development. These complex problems share a number of characteristics: there are a set of different options for future development,

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the need to include knowledge and values from diverse stakeholders and the public[1] as well as the necessity to gauge diverging goals and scrutinize possible trade-offs given high system uncertainties (Funtowicz and Ravetz 1993). Such complex decisional issues require an analytical framework that integrates multiple methods and allows for multi-criteria decision making with multiple stakeholders and the public (Petts 2004). Analytic methods to collaboration in sustainable development have only recently gained a more prominent role (see, e.g., Brown et al. 2001; McDaniels and Trousdale 2005; Scholz and Stauffacher 2007; Sheppard and Meitner 2005). Most of them apply a generalized model of a decision-making process distinguishing several phases: goal formation, system analysis, scenario construction, multi-criteria assessment, generation of orientations (Scholz et al. 2006). Sheppard and Meitner (2005: 184) emphasize that this can "help [to] bridge the gap between general participatory processes and complex decision-support systems". Based on our research in large-scale transdisciplinary projects in domains such as transportation, urban and rural development, tourism, radioactive waste management and regional clustering, we developed such a methodological framework, the Transdisciplinary Case Study (TdCS) design (for an overview, see Scholz et al. 2006). In parallel to the development of our TdCS design, a widespread discussion of different approaches to integrate science, stakeholders and the public in societal decision processes was and is still ongoing. Yet, stakeholder or public involvement in political decision processes is sometimes claimed being just another form of a corporatist regime – generally with a pejorative connotation (see, e.g., Hendriks 2002; Lowndes and Sullivan 2004; Ploger 2001). Personally concerned and affected by this, I would like to scrutinize what this claim actually means and if this argument really holds.

I proceed as follows. In Chapter 2 I introduce the concept of neocorporatism as it stands for more negotiated forms of policy making. Using scientific literature, I illustrate that neocorporatism has an economically 'neutral' effect but is at the same time socially less harmful – i.e. neocorporatism seems in fact able to address existing trade-offs in societal decision processes. More contradicting are the effects identified with respect to environmental issues. Whilst some research showed neocorporatist arrangements more successful in regulating environmental protection, others did not find such results.

I continue in Chapter 3 introducing our TdCS design. The term transdisciplinary refers in our understanding to a form of knowledge production whereby a mutual learning process between science and people from outside academia is aspired. Our conceptualization of science-practice collaboration is similar to but distinct from other frameworks like, e.g., Ortwin Renn's 'Cooperative Discourse' (Renn 1999) or various forms of stakeholder-based 'Multi-Criteria Analysis'. Case studies are used as phenomena investigated in sustainable development cannot be separated from their context. Cases are unique, but always related to something general.

In Chapter 4, I discuss if the TdCS design can be understood as neocorporatist arrangement. In a literal classical understanding this is certainly not the case. On

[1] We follow Chilvers (2007) in distinguishing between *stakeholders*, who represent interests of groups and *publics*, who represent primarily themselves but are potentially representative of different societal groups.

the other hand, in a broader process understanding, the TdCS resembles a neocorporatist like interest mediation. Yet, the TdCS goes well beyond neocorporatism – and the same holds for similar frameworks of science-based multi-stakeholder processes – as a larger number of interest groups are involved; the regional is more important than the national level; hierarchical, central steering of decision processes is replaced by a more networked form; the role played by science is emphasized; it is conceptualized more as mutual learning process than as interest negotiation; and a more project-oriented flexible approach substitutes institutional arrangements.

I conclude in Chapter 5 by showing some implications from this macrosociological perspective both for our own approach and similar approaches integrating science, stakeholders and the public in societal decision processes. Doing this, I will pay special emphasis to the role(s) science plays.

Neocorporatism: A Negotiated Form of Policy Making

The widespread discussion of approaches to further participation of various stakeholders and the public in societal decision processes has often led to claims this being just another form of corporatism. Answering this claim, I review here the discussion around this concept. This can of course not be a full review, but rather a collection of some major points that will allow us to later judge what this claim could mean and if this claim actually holds.

Streeck and Kenworthy (2005) show how the idea of corporatism evolves in the nineteenth-century Europe "to accommodate organized collectivities in a liberal polity and free-market economy" (ibid.: 443). In this understanding, corporate associations should both limit the power of nation states and of the market. Taken up by Mussolini in Italy, corporatist organization is then used "as an instrument of state rule" and organized groups "soon came under control of a dictatorial state" (ibid.: 444). "What on the surface remained a corporatist constitution soon became a facade for dictatorial state rule" (ibid.: 445). Schmitter (1974) therefore referred to this development as *state corporatism*. This very link of the term with the fascist regime in Italy can probably explain why the concept still today finds harsh opposition and is often used with a pejorative connotation. After World War II, Shonfield (1965) is one of the first authors taking up the term again. Shonfield (1965: 231) states that in corporatist economies, "major interest groups are brought together and encouraged to conclude a series of bargains about their future behaviour". He tries to free the term from ideological connotations to fascism and therefore his use is later referred to as *neocorporatism*; or democratic, societal, liberal corporatism (see, e.g., Bornschier 2005b, 2005c; Lijphart and Crepaz 1991; Siaroff 1999; Streeck and Kenworthy 2005). In the 1970s, Schmitter and Lehmbruch develop the concept further (Schmitter 1979; Schmitter and Lehmbruch 1979; Lehmbruch 1979). Schmitter focuses more on *structural aspects* of interest representation whilst Lehmbruch stresses the *process character* seeing "corporatism as an institutionalized pattern of policy formation in which large interest organizations cooperate with each other and with public authorities" (Lijphart and Crepaz 1991: 235). Streeck and Kenworthy (2005) further distinguish between concertation and self-government. Whilst *concertation* "refers to efforts by national governments to make unions and employers exercise their right to free collective bargaining in such way that it is not at odds with national objectives" (tripartite cooperation between government, employers and trade unions); *self-government* on the other hand "involves diverse forms of collective participation of organized groups in public policy" (ibid.: 449). According to Molina and Rhodes (2002: 324) since the 1990s neocorporatism "can best be understood in terms of networked form of governance […] beyond hierarchy and market". Yet this process focus has often been neglected and empirical applications have mostly focused on structural aspects (Molina and Rhodes 2002).

From the mid 1970s onwards the concept has been *empirically operationalized and tested* in several studies focusing on developed capitalist democracies, namely the member countries of the Organization for Economic Cooperation and Development, OECD (e.g., Lijphart and Crepaz 1991; Hicks and Swank 1992; Hicks and Kenworthy 1998; Siaroff 1999). Lijphart and Crepaz (1991) combine twelve existing measures in a new composite one that has later been used and further developed by many scholars. Hicks and Swank (1992) use a set of twelve indicators and develop a so called 'left corporatism'. Hicks and Kenworthy (1998: 1641) refer to this score as 'social democratically (and politically) tilted index' in contrast to the 'societally tilted index' of Lijphart and Crepaz (1991). They integrate these two different scores resulting in two dimensions: 'neocorporatism' and 'firm-level cooperation'. Siaroff (1999) summarizes twenty-three different studies and introduces again a process understanding of corporatism applying a summary index of eighth measure, like, e.g., level of strikes, nature and goals of trade unions, extent of co-determination in the workplace, nature of wage setting, and general nature of public-private interaction (Siaroff 1999: 194; later applied by, e.g., Lijphart 1999; Neumayer 2003).

These various measurement concepts have been applied in a number of studies. Reviewing this evidence Bornschier (2005b) illustrates that *neocorporatism is neutral regarding economic growth*; results in less income inequality and less poverty through increased welfare measurements (see as well Hicks and Kenworthy 1998; Lijphart 1999). Consequently, Bornschier concludes that this very success explains why neocorporatist regimes still persist. In his own analyses, Bornschier (2005a) illustrates that neocorporatism has been rather stable between 1960s and mid 1990s. The moderate overall weakening of neocorporatism he explains by the fact that in the Anglo-Saxon regimes the already low level of neocorporatism decreased constantly. As regards this rather stable situation, Bornschier offers an explanation referring to his 'Theory of Conflictive Evolution' (2005a: 350; see as well Bornschier 1988). According to an evolutionary understanding of modern societies, a given society is in constant flow and adapts in different areas to innovate and retain, e.g., economic prosperity. Following the ideas of Carlota Perez (1983) Bornschier stresses the discontinuous character of this societal change process (see, e.g., Bornschier 2005a; Bornschier 1988) and states how crucial developing mismatches are between, e.g., technological innovation and subsequent socio-institutional adaptation. In fact technological innovation and societal change processes are interwoven. Bornschier postulates that the latter is the condition for the implementation of the former. From this it becomes evident that in a time of increased technological innovation a bigger pressure to adapt societal processes should become visible. Hence, Bornschier expects that neocorporatist arrangements will certainly change and adapt to the new challenges posed by societal change and a *'new neocorporatism'* will evolve.

To continue my discussion of neocorporatism, I want to focus now on *environmental problems*, as this stands closer to our own work in processes of sustainable development. King and Borchardt (1994) – though not directly interested in corporatism but more in effects of left party power – find reduced pollution for corporatist regimes. Crepaz (1995) shows a negative correlation between degree of corporatism and pollution levels when controlling for per capita income, GDP growth, per capita consumption of energy, and political dominance of social democrat party. Jahn (1998: 120) finds "that corporatism has a highly significant positive effect on environmental performance". This effect remained in multivariate regression when controlling for geographical size, size of industrial production, population density, and Gross National Product. Scruggs (1999) finds as well a positive correlation between neocorporatism and environmental performance from the 1970s to 1990. Positive effects remain in multivariate regression models controlling for, e.g., energy use, nuclear power, income per capita, growth per capita. Scruggs (2001) re-examines and confirms these results using data from a more recent time period (1980–1995). Matthews (2001) analyses changes in fuel filth consumption and finds a significant but modest effect of corporatism in multivariate analyses. She concludes that "corporatist institutions are more adept at implementing policies that serve the broader interests and effectively overcome potential problems of collective action" (ibid.: 495–496). Neumayer (2003) criticizes these studies mainly for three reasons: the number of observations is small, often only cross-sectional data are used, and just ordinary least square estimation techniques applied. Neumayer utilizes advanced statistical techniques exploiting both fixed-effects and random-effects. He draws on panel data covering the time period 1990–1999. In contrast to the other studies, he finds that in "most cases, the corporatism variable tested insignificantly" and concludes that it "is probably a myth to believe that corporatism is good for the environment" (Neumayer 2003: 219). On the other hand, he finds a robust association between lower pollution levels and green or left-libertarian parliamentary strength. Hence, results here are not unequivocal.

The concept of *neocorporatism has been criticized* on various grounds. Place does not allow to review all critics but just to point to some major elements in the discourse. In a thorough analysis, Streit (1988) develops three arguments: (i) violation of democratic legitimacy and control; (ii) lack of solid theoretical basis; and (iii) the lack of the required steering knowledge. Streeck and Kenworthy (2005: 449) acknowledge the problematic role in democracy, that "a cartel of elites" with a powerless parliament can evolve. They show that social democrats as well as liberals are uncomfortable with neocorporatism. Whilst the former fear loss of union autonomy or less power for state interventions; the latter "eschew corporatism for its anticompetitive, monopolistic institutions and its inherent collectivism" (p. 449). Molina and Rhodes (2002) focus more on the empirical applications and criticize that often a static and structural understanding prevailed and that therefore the concept was "ill-prepared to explain the new economic developments in the 1990s" (p. 311). Overall most prevalent is certainly the critic with reference to the lack of democratic legitimacy and control. The integration of corporatist arrangements within democratically legitimized decision processes – be it either a parliamentarian system or in a direct democracy – seems crucial.

It is bewildering to see how this rather *elusive concept* has been measured differently but producing a mostly *consistent and overly positive picture* of neocorporatism. The empirical literature is, however, hardly ever addressing existing critical remarks but continues to search for evidence and refinements in showing that neocorporatism is economical successful. In the words of Streit (1988: 609): "neocorporatism seems to be justifiable according to the proverb that nothing succeeds like success or by legitimacy through performance". In fact, most of the studies actually fail to explain *how* performance can be improved by a neocorporatist regime. To this end, a more disaggregated view would certainly be necessary and helpful (Clemens and Cook 1999). This would then as well allow to judge if democratic processes are really endangered by neocorporatism. Further this would as well enable to scrutinize if enough knowledge is available to steer, e.g., economical development. Neglecting this aspect seems most critical as many present societal problems – not least in the realm of sustainable development – need more than negotiation between different interests but a more analytical approach to collaborative problem solving. It is exactly along these lines that our own work has been developed.

TdCS as Methodological Frame for Collaborative Learning Processes in Sustainable Development

I continue with the presentation of a framework developed at the ETH Zürich to research and develop complex societal problems where environmental issues are at stake, the so called *Transdisciplinary Case Study (TdCS)* design. The TdCS design was developed within a teaching course (Stauffacher et al. 2006) but evolved far beyond. The term transdisciplinary refers to a form of knowledge production that (a) deals with relevant, complex societal problems; (b) complements traditional disciplinary and interdisciplinary scientific activities by integrating actors from outside academia; and (c) organizes processes of mutual learning among science and society (Scholz et al. 2000). A case study is an appropriate research methodology if the phenomenon investigated cannot be separated from its context. A case is unique, and always related to something general. Hence, the TdCS design offers a framework that allows collaborative learning processes in addressing 'wicked' problems (Rittel and Webber 1973) as, e.g., in sustainable development. Here I only give a short presentation of our key terms used and our main principles followed; further details can be found elsewhere.[2]

Our use of the term *collaboration* is deliberate though many others are used in the field (e.g., participatory, communicative, and interactive). Thereby we would like to stress the importance of a ‘true partnership’ in a mutual learning process – with reference to the seminal idea of a ‘ladder of citizen participation’ introduced by Arnstein (1969). But our approach goes beyond most collaborative approaches that focus mainly the participatory process (e.g., Forester 1989; Healey 1998; Innes 1998; Sager 1994). In general, they give no guidance how to tackle analytically the substantive decision problem at hand (Gregory et al. 2005). In contrast, we follow a model of a *strategic decision process* (see Mintzberg et al. 1976): analysis of the present situation, identification and description of the decision problem; development of options; evaluation of these options; and elaboration of strategies.

Table 12.1 The major analytical steps of the TdCS design

Step	Description
1 – Define a guiding question (Scholz and Tietje 2002: 84–86, 268–269)	The research team together with stakeholders jointly defines the guiding question. Key here is a common problem understanding.
2 – ‘System Analysis’ (Scholz and Tietje 2002: 48–54, 87–88, 241–246)	Analyzing media and relevant statistical data enables to determine important structures and dynamics of the case. Literature review, expert interviews and surveys help describing the case. We develop a set of 10–15 impact factors considered relevant and sufficient to describe the current state. Impact matrixes, system grids, Mic-Mac-Analysis, system graphs deepen our understanding of the system and its dynamics (for details, see Scholz and Tietje 2002).
3 – Construct scenarios using ‘Formative Scenario Analysis’ (Scholz and Tietje 2002: 105–116; see as well Wiek et al. 2006)	We define two to three levels of development for each impact factor. A scenario then is defined as a complete combination of levels of all impact factors. Using consistency analysis those scenarios exhibiting high inconsistency scores are discarded. The final selection of scenarios is done jointly with a group of stakeholders.
4 – ‘Multi-Criteria Analysis’ (MCA) (Scholz and Tietje 2002: 143–173, 197–224)	We derive a small set of six to twelve evaluation criteria in consultation with stakeholders. We apply two different approaches of MCA: (a) calculations based on data, literature and expert interviews (data based evaluation MCA I); (b) stakeholder groups – at least six persons each – provide their preference ratings (stakeholder based evaluation, MCA II). MCA II evaluation is made in two steps: overall ‘holistic’ and still intuitively, but using the criteria from the MCA I.
5 – Results discussion, strategy development (Scholz and Tietje 2002: 114–115, 268–269)	We discuss jointly with stakeholders the results of the above steps in workshops and develop orientations for future action.

[2] For a more detailed discussion, please refer to Scholz et al. 2006; Scholz and Tietje 2002.

Our analytical steps of the TdCS design are as follows (Table 12.1).

- We start from the case, describe its respective problems jointly together with stakeholders.
- Based on intensive analytical work, we describe the case as a system with impact factors and their relations ('system analysis', Scholz and Tietje 2002: 48–54).
- We construct scenarios of future development and choose together with stakeholders three to four distinctive ones ('formative scenario analysis', Scholz and Tietje 2002: 105–116).
- We evaluate these scenarios using different methods. On one hand we use data, models and calculations (multi-criteria analysis, Scholz and Tietje 2002: 143–173). On the other hand, we assess preferences of contrasting interest groups in a so called "exploration parcours" (Scholz and Tietje 2002: 197–224). This allows us to detect areas of consensus or dissent and diverging perceptions – an essential basis for possible subsequent negotiations among stakeholders.
- At last, we integrate all results, discuss them with stakeholders and derive jointly orientations for future action.

Compared with other approaches like, e.g., Renn's 'Cooperative Discourse' (Renn 1999) and various forms of stakeholder-based 'Multi-Criteria Analysis' (Brown et al. 2001; McDaniels and Trousdale 2005; Sheppard and Meitner 2005) the TdCS design offers at least four distinctive elements. Firstly, the *joint problem definition* at the beginning seems to us crucial as here a first step towards true collaboration and joint ownership of the problem is made. Secondly, the *comprehensive, context rich description of present situation and future scenarios* does not only allow subsequent evaluation but gives important insights for the problem understanding and helps finding scenarios where the evaluation outcome is not evident and trade-offs are necessary. Thirdly, we stress the *equal footing of data based and stakeholder based evaluation* in our approach: so can, e.g., the first point out to flaws in perceptions of stakeholders or the latter can help identifying inadequate models or system boundaries of our calculations. Both together will certainly provide more robust results. Last not least, we emphasize the *learning process* inherent in our approach. The very process of assessing the present situation; developing future scenarios; and their detailed evaluation actually can induce a learning process. It can empower and motivate stakeholders to contribute more actively in a subsequent implementation or other decision processes, an outcome documented in similar studies (Brown et al. 2001; Sheppard and Meitner 2005).

Summarizing, the essential characteristics of our TdCS can be attributed to its specific approach both in addressing (a) collaboration and (b) the actual decision problem.

(a) Each phase of the TdCS has its specific and adequate form of collaboration (Stauffacher et al. 2008a). In fact, no process of a complex decision-making problem just needs one level of collaboration; it will rather span different levels at different points in time. The intensity depends on the phase and its specific goals – a *functional-dynamic approach*. This holds not only for transdisciplinary research – the cooperation between research and society – but in our experience as well for collaboration in societal decision making in general like, e.g., land use and landscape development (Scholz et al. 2002); radioactive waste management (Scholz et al. 2007; Stauffacher et al. 2008b); transport and urban development (Scholz et al. 2004).

(b) For the whole process a systematic procedure is crucial. Our *systematic-analytical approach* allows the integration of knowledge from different sources (Scholz and Tietje 2002) – key for addressing wicked problems. In contrast to less analytic and systematic approaches of collaborative planning, stakeholder input is documented and can be followed in the further process, transparency of stakeholder participation is guaranteed – an essential characteristic for stakeholder based Multi-Criteria Analysis approaches (Balasubramaniam and Voulvoulis 2005; Joubert et al. 1997).

Hence, we see that collaboration among different stakeholder groups is a central issue in our TdCS design. Negotiation are not at the core, but more a learning process, giving stakeholders and the public the possibility to learn more about the decision problem in a structured and transparent way (Belton and Pictet 1997; Gregory et al. 2005; Joubert et al. 1997; Lahdelma et al. 2000; McDaniels and Gregory 2004).

TdCS Design as Neocorporatist Institutional Arrangement?

Experts in the field of *sustainable development emphasize the importance of the involvement of different stakeholder groups from public and private sphere in an interest negotiation process* (see, e.g., Laws et al. 2004). This resembles the situation of neocorporatist arrangements where interest groups are brought together in a series of bargains about their future behavior. Yet, the idea to include non-economic interest groups like environmental organizations was not foreseen in neocorporatism (Downes 1996). In his thorough analysis Downes proposes some major reasons for this non-inclusion. As the state did not depend on the cooperation of non-economic interest groups for the implementation of policies, they were not involved. Further, non-economic interest groups were only poorly organized, could not ensure compliance to the outcome of agreements and were therefore not allowed to participate in corporatist arrangements. As Downes illustrates, some environmental organizations have, however, certainly potential influence and are strongly organized.

Following Lehmbruch in his process understanding of neocorporatism, Downes concludes that a *stakeholder process for sustainable development "resembles a neo-corporatist interest intermediation structure"* (Downes 1996: 182). Against this, Scruggs (1999) cites advocates of environmental reforms who have two major criticisms against neocorporatist arrangements: dominant economic interest groups are hostile to environmental interests and neocorporatist arrangements are not able to incorporate ecological issues. Yet, as Scruggs details industry probably favors neocorporatist arrangements against direct environmental regulation; neocorporatist arrangements can provide a framework for effective learning; and have the "ability to pursue public goods" (1999: 5). Scruggs concludes that "several factors seem to suggest that corporatist arrangements may be effective ways to regulate environmental pollution" (p. 8). This can be further illustrated by the study of Lahusen (2000) on 'cooperative environmental regulation' in France, Germany, Great Britain and the US. 'Cooperative environmental regulation' – understood as "any working relationship between the state and society […] which aims to prepare, produce and implement commonly supported measures of environmental pollution abatement or prevention" (ibid.: 255) – exists in all these four countries. Yet it takes four distinctive forms: "a deliberative consensus model in Germany, a rationalist style of etatism in France, a pragmatist compromise model in Great Britain and a pluralist and adversarial competition style in the USA" (ibid.: 257–258). Hence, on this basis Germany could be understood as a further case for the importance of neocorporatist arrangements in environmental policy.

Turning back to our own work, I argue that our *TdCS design is not a neocorporatist arrangement in the still common and classical understanding of neocorporatism*, focusing mainly on existing structures that allow negotiation of wages and working conditions among national business confederations and trade unions. On the other hand, we can look at it from the more general definition by Shonfield (1965: 231) that in corporatist economies, "major interest groups are brought together and encouraged to conclude a series of bargains about their future behavior". In this sense, the TdCS design could be understood as an institutional arrangement for neocorporatist regimes. This holds especially if neocorporatism is "understood in terms of networked form of governance" (Molina and Rhodes 2002: 324). I concur therefore with Downes (1996) that in a process understanding of neocorporatism, such a multi-stakeholder process for sustainable development is similar to interest mediation in a neocorporatist regime.

Sustainable development involves not only economic wealth but considers as well environmental and societal aspects. Therefore in contrast to classical neocorporatist arrangements *a much large number of stakeholder groups have to be involved and multiple outcome criteria reviewed*. In contrast to the often hierarchical and elite approach of neocorporatist arrangements giving the national state level ample importance, TdCS is mainly applied locally. It is the *regional level*, where social networks are strongest – i.e. mutual trust exists – and hence negotiations among diverging views are possible. The importance of trust as cultural resource for neocorporatism has been stressed by Bornschier (2005b). Generalized trust is a prerequisite for the generation of social capital (Bornschier 2000) and facilitates innovations and their diffusion (Bornschier 2005b, c). Trust plays therefore a pivotal role in collaborative processes such as TdCS or similar approaches. If trust is not available it needs to be obtained – a hard and time consuming process in all our TdCS. It is well documented in the literature that in fact trust is much easier lost than built (see, e.g., Anheier and Kendall 2002; Delhey and Newton 2003; Nuissl 2005). More important than classical neocorporatist structures are certainly the general *dynamic patterns of negotiated and deliberative processes*. This is in line with conclusions by Molina and Rhodes (2002) who stress the importance of a deliberative process of learning in understanding neocorporatism.

Yet, the *TdCS design goes well beyond neocorporatism* – and the same holds for similar frameworks of science-based multi-stakeholder processes: a larger number of stakeholder groups are involved; the regional is more important than the national level; hierarchical, central steering of decision process is replaced by a more networked form; the role played by science is emphasized; it is conceptualized more as mutual learning process than as interest negotiation; and a more project-oriented flexible approach substitutes institutionalized arrangements (Table 12.2).

Summing up, we can *either refute the claim that our TdCS design or other multi-stakeholder processes are examples of corporatist arrangements* by referring to the still prevalent classical understanding of neocorporatism. *Or more provocative: yes, our design – as similar other approaches – is in fact an example of a neocorporatist arrangement* in societal decision making. In the latter case, I would contest the negative connotation linked to corporatism. Often this claim is guided by an outdated understanding of corporatism not taking into account current discussion within the research community (see, e.g., Molina and Rhodes 2002). On the other hand, some critical arguments need to be addressed. Crucial seems certainly its (potential) democratic deficits. For this, integration with regular political decisions processes is essential. There is an urgent need for further work here, as more inclusive approaches are gaining prominence and therefore interfaces between informal and formal procedures need to be defined. Though, it is important to be aware that such interfaces will be different in different political contexts. For me the TdCS design as other multi-stakeholder processes are to complement more traditional and democratically legitimized forms of decision making not to replace them.

A further point that is yet rarely discussed (for an exception see Streit 1988) but maybe even more important: the *role of knowledge*. In my view, the centralized steering idea is to be rejected and has to be replaced by the metaphor of an ongoing learning process. Knowledge is crucial as complex and ‘wicked’ problems necessitate a thorough and comprehensive understanding. Science by its societal function is dedicated to contribute here – not exclusively or alone but according to the expertise scientists possess in specific fields (Collins and Evans 2002). This brings about some crucial questions which role(s) science can or should fulfill. I will conclude by discussing this now.

Table 12.2 Comparison of neocorporatism with our TdCS design

Neocorporatism	TdCS design
Issue: political economy	New issues: environmental problems, health, etc.
Fixed groups	Participation according to the ‘needs’, larger number
Interest mediation as primary aim	Mutual learning as essential goal
Role of science marginal	Role of science essential and crucial/critical
Role of state actors as initiator and moderator	Role of state actors to be determined (flexible)/yet unclear
Only at the national level	Mostly at regional/local level
Hierarchical, central steering of decision process	Networked form of steering

Beyond Neocorporatism: The Role of Science Crucial

We have seen that neocorporatist arrangements have been economically successful and have persisted. Yet, it is to be expected (1) that neocorporatism will itself need to be adapted and has to follow a less hierarchical and centralized approach (or already has); (2) that neocorporatism will need to incorporate more and different interest groups when addressing environmental problems, leading probably again to different institutional forms; and (3) an integrated framework has to develop where economical, societal as well as environmental performance and inherent trade-offs can be tackled at the same time. In my view, the TdCS design can be understood as an instrument along these lines. Whether or not we understand our TdCS design as neocorporatist institutional arrangement in policy making, due to the prominent role of science, we as *scientists are confronted in such projects with some challenges* that need to be tackled seriously.

Challenges for science being involved in societal decision processes have been discussed in the literature regularly. Place does not allow to give a full review here, but I would like to sketch some few concepts. Funtowicz and Ravetz coined the term of ‘post-normal science’ that emerged in “response to challenges of policy issues of risk and the environment” (1993: 739). A new mode of knowledge production has been proposed in the mid 1990s also by Gibbons, Nowotny and colleagues (see, e.g., Gibbons et al. 1994). According to Gibbons and Nowotny the so called *‘mode 2’ science* has rapidly evolved besides ‘mode 1’ science. Whilst the former is transdisciplinary, problem-solving oriented, standing in a societal real-world context and uses robustness as important quality criterion, the latter is monodisciplinary, oriented towards pure science in an academic context and strives for reliability. In ‘mode 2’, scientific experts and expert knowledge from outside universities should meet up in an agora, a kind of marketplace of ideas and knowledge (Nowotny et al. 2001). This resembles the *‘transdisciplinarity studio’* proposed by Scholz and Marks (2001). Here scientists and people from outside academia cooperate for a certain period of time and are then going back to their proper working context. Hence, Scholz and Marks maintain existing boundaries and division of labor between science and, e.g., policy makers. Yet, a mutual learning process among science and persons from outside academia should become possible (Scholz 2000; Scholz et al. 2000). A further concept worth to be noted is the so called *‘triple helix of innovation’* (see, e.g., Etzkowitz and Leydesdorff 2000). According to this concept, “the university can play an enhanced role in innovation in increasingly knowledge-based societies.” (Etzkowitz and Leydesdorff 2000: 109). In this model, tri-lateral networks of academia, state and industry work together on innovation processes. Still, these new or different forms of knowledge production have several implications which need to be acknowledged.

The *researchers’ autonomy might be endangered* in the TdCS. As transdisciplinary researcher, I have to balance between on one hand methodological rigor and soundness; and on the other hand transparence and understandability for persons outside academia. I have to do the splits between scientific credibility – generally gained by publications in peer reviewed journals – and practical relevance of the process and the results – gained in intense and extensive field work. This has been described recently similarly by Elwood (2007: 2292): “University – community collaboration may necessitate producing two kinds of outputs, those that meet the needs of community participants and those that are likely to be recognized in an academic context.” It is vital that results gained in TdCS will be published whatsoever they are. In this respect, the researchers’ autonomy has to be respected. Looking at collaboration between science and stakeholders from the other side*, the stakeholders’ autonomy is at stake, too*. Policy makers might fear that researchers will try to influence decision making and thus undermine legitimate democratic processes. In the understanding of our TdCS design, researchers are not to decide but to support knowledge production in the issue at hand. The division of labor between science and practitioners remains but “transverse communication and interaction between actors” is strengthened (Shinn 2005: 731). This stands in contrast to Gibbons and Nowotny, who are blamed to be ‘anti-differentiationists’ (Shinn 2002: 604).

Both *science and people from outside academia cede part of their autonomy, but must at the same time allow freedom and fulfillment of each other’s primary societal function* (Stauffacher 2006). This implies that – at the same time as intensity and form of collaboration are adjusted – a continuous process of mutual differentiation is required. This very process is called ‘boundary work’ in sociology of sciences (Gieryn 1983). In my observation, this is only hardly reflected in applied research, consultancy or other approaches integrating science and policy making or business innovation processes. Yet, such reflections are essential for university researchers in times when pressure on more external funding is increasing and straightforward segregations between university and the rest of the society are no longer tenable. It needs to be acknowledged though, that the present education system does only badly prepare students and scholars for such questions – our TdCS design as a teaching tool offers such a place, where these issues can be discussed and learned (Stauffacher et al. 2006; Stauffacher and Scholz 2008).

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Chapter 13
Social Practices and Sustainable Consumption: Benefits and Limitations of a New Theoretical Approach

Karl-Werner Brand

Abstract In environmental and consumer policy it has become common place to view the 'critical consumer' as the decisive agent for a change towards sustainable consumption. Private consumption, however, cannot be understood adequately as a matter of 'personal choice'. Individualistic approaches do not take into account the complex socio-technical nature of consumption, its dependency on 'systems of provison', its varying symbolic meanings across social milieus, and the systematic interlinkage of consumption practices and conventions of everyday life. The paper contends that practice-theoretical approaches provide a better understanding of these complex interdependencies. In a first section the basic assumptions of these approaches are summarized. Focused on routine practices these approaches, usually, do not deal with the question of how consumption patterns can be changed intentionally by political intervention, however. Based on an empirical case study on the German "Agrarwende" politics – an attempt to bring organic food from the niche to the center of German food markets in 2001–2005 – in a second section, the paper therefore explores the question in how far practice approaches can also be utilized for a better understanding of the problems of promoting sustainable lifestyles by political measures.

Keywords Practice theory • Sustainable consumption • Sustainable food policies • BSE • Greening of lifestyles

The Problem: How to Understand Sustainable Consumption

During the past 4 decades, public concern on environmental problems has grown considerably all over the world. Whereas the ecological debate was marked by a high degree of polarization throughout the 1970s and 1980s, today nobody seriously

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doubts the urgency of ecological problems any longer. At least in Western societies ecological concerns have become more or less institutionalized in public discourses, politics, economy and everyday life. Nevertheless, even here the shift of social practices in a more sustainable direction has so far been a slow, unwieldy process marked by contradictions and with ambiguous results. There are a number of reasons for this. At the level of institutional actors, there is still little consensus as to what kind of measures are both ‘appropriate’ in terms of problem solving and ‘fair’ in terms of shared burdens. This reflects a complex structure of interest and power relations, which varies from issue to issue. But also at the level of everyday life neither a high awareness of environmental problems nor the willingness to contribute to their solution provides a sufficient basis for more or less consistent pro-environmental behavior. As social environmental research has shown (e.g., Brand 1997; de Haan and Kuckartz 1996; Diekmann and Preisendörfer 1998; Kollmuss and Agyeman 2002; Middlemiss and Young 2008), the link between environmental awareness and pro-environmental attitudes, on the one hand, and environmental behavior, on the other, is generally rather weak. Moreover, environmental behavior, in nearly all cases, shows a very inconsistent pattern, even among people with strong pro-environmental beliefs. A pronounced environmental sensitivity in one domain of action (e.g., food consumption, use of water and energy, or transport) is often combined with an astonishing indifference in others. These findings are not very surprising considering the difficulty of making actual choices in line with strict ecological criteria in a society geared toward the Western way of life, economic growth, material affluence and technological progress. Institutional efforts to establish new and more environmentally friendly practices encounter a host of structural barriers. Individual choices are complicated by incomplete and overly complex information, adverse price incentives, poor supply, insufficient infrastructural arrangements, practical inconveniences, contradictory interests, values and norms which all render the ideal of consistent pro-environmental behavior a particularly intricate venture.

The difficulties of finding a convincing and comprehensive answer to the question of how to overcome these barriers are not only due to this unfavorable social context. They are also reinforced by the way that social scientists deal with these problems. The disciplinary fragmentation of research in general and the heterogeneity of approaches in social sciences in particular systematically direct attention only to partial aspects of the problem. Accordingly, psychology and economics exclusively focus on individual decisions. In the case of psychology, such decisions are attributed to attitudes, values, norms and motivations (van Kasteren 2008), in economic or in rational choice theory to ‘rational’ cost-benefit calculations, which typically entrap individual environmental behavior in ‘social dilemma’ situations (Diekmann 1996). Sociological studies criticize the individualistic assumptions of these approaches. They, in contrast, emphasize the social and cultural embeddedness of environmental behavior and focus on the symbolic meaning of lifestyles and consumption (Baumann 1992; Featherstone 1991; Reusswig 1994). Neither of these approaches, however, adequately considers the material dimension of social practices, the fact of everyday behavior and consumption being systematically enmeshed with socio-technical systems and being embedded in specific spatial structures, in urban or rural settings.

The discourse on sustainable development in the 1990s not only substantially reframed the environmental debate, but also restructured scientific research on environmental awareness and behavior. The 'Agenda 21', adopted at the 1992 UNCED conference in Rio de Janeiro, assigned change of consumption and production patterns a key role in achieving sustainable development. Since then, 'sustainable consumption & production' has become a central cross-cutting issue in various international funding and research programs. For this reason, at least in the European context, research on environmental behavior since the late 1990s has mostly turned into research on obstacles to and drivers of 'sustainable consumption' (Tukker et al. 2008). This also involved a shift in perspective. Instead of focusing on the 'conspicuous', highly symbolical side of consumption, the more hidden aspects of daily consumption like housing, heating, washing, cooking and mobility etc., which are strongly shaped by technical systems have come to the fore (Southerton et al. 2004). These patterns of 'ordinary consumption' (Gronow and Warde 2001) are not only highly routinized; they also have a high environmental impact.

The new attention of sociologists for the technically formed, infrastructural aspects of daily life has allowed to more easily bridge the gap to the other, natural science strand of ecological consumption research, preoccupied with the material and energetic metabolism of consumption (Sachs et al. 1998; Fischer-Kowalski 1998; Fischer-Kowalski and Hüttler 1998). If consumption is regarded as a specific stage in the life cycle of products, the analysis of environmental flows related to global commodity chains or various systems of provision move to the center stage of research. The focus on the material implications of consumption has further led to the setting of priority areas for 'transition management' (Loorbach 2007): due to their high energy and material demands, housing, transport, food and agriculture are now considered as the most relevant areas for sustainable production and consumption (Spangenberg and Lorek 2002).

Currently, most research in these areas is carried out by publicly funded inter- and transdisciplinary research networks. This raises new questions not only in regard to the management of such projects but also in respect to methods capable of integrating knowledge from different disciplinary backgrounds. From the side of natural sciences, systems-theoretical models are generally used to integrate such diverse bodies of knowledge. However, integrations of this type usually only works at the expense of the cultural dimension of social action. From a social theoretical perspective, Andreas Reckwitz and Theodore Schatzki (cf. Reckwitz 2000, 2002, 2003; Schatzki 1996, 2001; Schatzki et al. 2001) have introduced a new 'practice theoretical approach' for some years now, which also claims to provide a framework for an integrative analysis of social and material aspects of 'social practices' by merging diverse strands of social theories (Bourdieu, Giddens, social phenomenology, post-structuralism, pragmatism, science and technology studies etc.) While, in Germany, this approach has mainly been discussed at the theoretical level and more widespread use in empirical research has been limited to studies in the sociology of technology, a number of more recent English and Dutch studies have explicitly employed it in analyzing sustainable consumption (Shove 2003; Shove and Warde 2002; Spaargaren 2004; Warde 2005). From this perspective, the development of consumption patterns can be grasped as a process of co-evolution linking technical, economic, social and cultural developments within the context of everyday practices.

This article aims to assess the usefulness of this approach by drawing on an empirical case that does not correspond to the typical areas in which practice approaches are usually applied. To this end, first, the basic assumptions of the theory of social practices and its approach to (sustainable) consumption will be outlined in the second section. The third section will present the results of a recently completed case study on the effects of the German *Agrarwende* – the proclaimed radical change in agricultural policy as reaction to the BSE-crisis in Germany in 2001. The study focuses on a basic element of this program: the rapid development of organic farming with the goal of moving organic food from a niche market to the center of German food markets. In the final section, based on the empirical findings of this study, I will outline a general 'context model' of promoting sustainable consumption and discuss the question as to what extent practice theory can provide an adequate understanding of the core dimensions of this model and which aspects of the story call for complementary accounts.

Practice Theory and Sustainable Consumption: A Theoretical Framework

The general characteristics of the social practice approaches can be summarized in five points:

1. Social practices as basic units of social analysis

A first central element of practice theories refers to what is conceived of as the core unit of sociological analysis. "Practice accounts are joined in the belief that such phenomena as knowledge, meaning, human activity, science, power, language, social institutions, and historical transformations occur within and are aspects or components of the field of practice" (Schatzki 2001: 2). The social is neither reduced to rational actions of individuals (homo economicus) nor to value-based normative rules (homo sociologicus) or to symbolic structures 'inside' or 'outside' of the individual mind (social phenomenology, discourse, communicative interaction); rather it is located in social practices as the basic units of social existence (Reckwitz 2002; Warde 2004).

> " 'Practices' in the sense of the theory of social practices (…) is a routinized type of behavior which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge. (…) A practice – a way of cooking, of consuming, of working, of investigating, of taking care of oneself or of others – forms so to speak a 'block' (…) which cannot be reduced to one

> of these elements. (It) represents a pattern which can be filled out by a multitude of single and often unique actions reproducing the practice".
>
> (Reckwitz 2002: 249ff)

This approach undercuts the old dichotomies of sociological debate: micro vs. macro, individualist vs. structural approaches. Its basic assumption is that institutional structures, knowledge systems and normative rules, the distribution of power, resources and capital become reality only by 'doing', in the process of engaging in particular practices. This is what Giddens calls the 'duality of structure'. "The structural properties of social systems are both medium and outcome of the practices they recursively organize" (Giddens 1984: 25). A decisive prerequisite for this recursive character of social life is the routinization of social activities. Social practices are such routinized, situated, and materially interwoven patterns of activities. "A practice is a (…) routinized way in which bodies are moved, objects are handled, subjects are treated, things are described and the world is understood" (Reckwitz 2002: 250). They gain their repetitive, socially typified character through a 'shared practical understanding' (Schatzki 2001: 2), through implicit, embodied schemes of knowledge and behavior (practical knowledge, know-how, esthetic standards, cultural codes of self-discipline etc.). In Bourdieu's theory, these implicit schemes are closely connected with the *habitus*-concept and corresponding class-specific lifestyles (Bourdieu 1984). Following a practice approach, thus, means to study the problems of sustainable consumption in the context of situated everyday practices and to reconstruct the implicit 'practical understandings' of the various consumption practices.

2. Social practices, consumption and individuality

Theories of social practices involve a decentered concept of action. The basic units of analysis are not individuals but social practices. If practices are a bundle of interconnected, more or less coherent actions formed around a particular activity, individuals are engaged in many of those activities. "The single individual – as a bodily and mental agent – acts as the 'carrier' of a practice – and, in fact, of many different practices which need not be coordinated with one another" (Reckwitz 2002: 249ff). From this point of view, 'individual identity' develops reflexively from the interconnections subjectively established between these heterogeneous practices in the course of one's life. This conceptualisation of social practices and individuality has considerable consequences for the analysis of sustainable consumption. If individuals are continuously involved in a host of heterogeneous practices, the idea of a consistently ecological "rationalization of lifestyles" would definitely be an illusion (Hobson 2002). The necessary individual "interpretative treatment of the crossings of different mental and bodily routines" involving one's own mind and body (Reckwitz 2002: 257) nevertheless opens up a number of ways of dealing with contradictions and cognitive dissonance. Striving for a higher degree of consistency is but one possibility.

To be sure, consumption is "not itself a practice but is, rather, a moment in almost every practice" (Warde 2005: 137). This reduces the individual opportunities for changing consumption patterns. Using more or less energy, for example, is only to a very limited extent an individual choice; it is above all an integral part of social practices like living in certain living arrangements, commuting, washing, cooking, eating, driving, etc., all of which are by their very nature systemically – technically, economically, and culturally – interwoven in a particular type of society (Brand 2008; Southerton, Warde and Hand 2004). A practice theoretical approach, thus, has to trace the ways social practices mesh things, actors, and symbols and to explore the kind of consumption connected with these practices. It has to analyze the opportunities actors may have for rearranging the connections between social and technical elements of certain practices. And it has to study how practices in one domain of social life relate to those in other domains and what kinds of conflicts may arise from such interrelations.

3. Routine practices between reproduction and change

In general, practice approaches focus on day-to-day routines. "Theories of social practices (...) emphasize the routine, pragmatic, recursive, 'ordinary' and every-day-life character of action" (Spaargaren 2006: 12). This does not necessarily imply a conservative bias towards institutionalized, reproductive practices. On the one hand, routines do have a stabilizing function; they relieve the subject from conscious, discursive modes of action. Thus, individuals always try to cope with new, unfamiliar situations by drawing on familiar routines, categorizations and typologies (Schütz and Luckmann 1991). As pragmatism (Pierce, Mead, Dewey) has pointed out, implicit practical knowledge, on the other hand, also implies a creative capacity to deal with new, constantly changing situations or with failure (Hörning 2001; Joas 1993). The uncertainty about the future, the fact that individuals permanently face the need to cope with surprises, and the necessity to coordinate heterogeneous practices force a basic 'openness' of social practices (Reckwitz 2003: 294ff). Whereas most of the necessary modifications of social practices happen in a routine mode of adaption, based on an ongoing 'reflexive monitoring' of activities (Giddens 1984), there may also be stronger irritations, biographical ruptures or catastrophic events that question routinized action schemes more fundamentally. "For practice theory, the breaking and shifting of 'structures' must take place in everyday crisis of routines, in constellations of interpretative indeterminacy and of the inadequacy of knowledge with which the agent, carrying out a practice, is confronted in the face of a 'situation'" (Reckwitz 2002: 255). This necessitates actors to "switch from the level of practical consciousness to the level of discursive consciousness and start (re) considering past and future alternative courses of action" (Spaargaren 2006: 13). In doing so, individuals can get engaged in new, more sustainable social practices. As many empirical studies have shown, public risk controversies, food scandals, or dramatic narratives on environmental degradation and the consequences of climate change can be experienced as a challenging, de-routinizing situation that may, to some extent, create a willingness to change consumption habits. Whether this leads to new practices depends on the availability and acceptability of new role models, services, or products that fit into the existing order of everyday life.

4. The material nature of social practices

A further feature of practice approaches – and a veritable gain for research in environmental sociology – is the prominent and systematic position granted the material nature of social practices. This gives way to a view of the social as "a field of embodied, materially interwoven practices centrally organized around shared practical understandings" (Schatzki 2001: 3). Giddens and Bourdieu discuss this aspect by emphasizing the bodily character of social practices. Social, typified action is only rendered possible by embodied schemes and dispositions. Giddens, in addition, introduces the concept of 'regionalization' in sociological theory, which refers both to the 'positioning of the body in social encounters' (Giddens 1984: XXIV) and to the varying spatial settings of interaction. Particular localities are routinely connected and coordinated with (or they may exclude) specific types of activities. In reaction to the challenge of actor-network theory (Latour 2005; Law and Hassard 1999), the proponents of practice theory have extended this concept of 'materiality' to technological aspects of social practices. They agree with ANT on the inseparable interlocking of the social, technical and material world. However, they hardly go as far as Latour, who contends that stable social order, detached from space and time, is possible only due to the technical intermediation of human actions – 'technology is society made durable' (Latour 1991). Practice theorists do not conceive of men, things and technologies as 'acting' co-players of the same kind. They stick to the (humanistic) assumption that technical-material structures do not simply impose themselves on social action; rather they see them as integral part of the 'practical meaning' of things.

In any case, practice approaches turn our attention to the mutual structuring and interlinking of social and material aspects in the development of social practices and the consumption patterns involved (see, for example, Shove 2003).

5. Power, inequality and social practices

Whereas these four points describe the basic elements of the new practice approach in the social sciences and its relevance for studies on sustainable consumption, it still needs to be complemented by some key categories of sociological analysis, such as power, domination, and inequality. Although Reckwitz and Schatzki do not pay much attention to these structural categories, they play a crucial role in the work of the two "classical" proponents of sociological practice theories, Anthony Giddens and Pierre Bourdieu. In Giddens' perspective, power is a constitutive element of social action. It means to be able "to intervene in the world, or to refrain from such intervention, with the effect of influencing a specific process or state of affairs" (Giddens 1984:14). This ability is based on 'allocative' and 'authoritative' resources. Social structures are characterized by a specific linkage of power resources with rules of interaction. 'Rules' again have two aspects: on the one hand, they constitute meaning (by modes of signification); on the other, they normatively sanction modes of social conduct (ibid.: 18, 28ff). Power, meaning and norms, thus, are inseparably interlaced in all kinds of social interactions. To become an institution, such patterns of interaction have to be stabilized across time and space, reproduced by the daily practices of social actors in different spatial and temporal contexts. Structure, in this sense, both constrains and enables social activities (ibid.: 25).

The more the structural properties of social systems stretch away in time and space, increasing the gap between the modes of social and system integration, the more structural developments evade the control of any individual actor (ibid.: 25). In interpreting these complex, opaque interrelations between everyday activities and structural patterns, social actors may resort to symbolically highly simplified, personalized, reified or naturalized categories: in any case, these interpretations become an integral part of the 'practical understanding' of reality and are, as such, a precondition for the persistent reproduction and structuration of social life. The flow of action, however, "continually produces consequences which are unintended by the actors" (ibid.: 27). Human history, thus, "is not an intended project" (ibid.: 27). Even if "strategically placed actors seek reflexively to regulate the overall conditions of system reproduction", human history "persistently eludes efforts to bring it under conscious direction" (ibid.: 27).

This is a quite discouraging message to those who subscribe to the program of 'transition management' (Loorbach 2007). Nevertheless, Giddens' approach provides a profound analytical framework for studying the question of how power, meaning and norms structure the various domains of social practice and the consumption options they give rise to – even though he himself did not elaborate this program systematically. Nonetheless, his analyses of modern, post-traditional societies provide some clues for understanding the changing role of consumption in societal power relations (Giddens 1990, 1991). In line with other theorists of 'reflexive modernity' (Beck 1992; Beck et al. 1994), Giddens stresses that accelerated processes of social disembedding, individualization, and growing uncertainties produce a more reflexive pattern of life. Lifestyles – understood as a particular set of social practices people are embedded in when living their daily life – increasingly become a matter of choice. As social and ecological implications of world-wide production-consumption chains have, at the same time, attained higher visibility in public discourse, strategies of 'political consumerism' (Micheletti 2003) and 'lifestyle politics' (Giddens 1991) have gained in importance. Spaargaren recently has elaborated these different forms of 'empowerment of citizen-consumers' in more detail (Spaargaren 2007).

While Bourdieu emphasizes the central role of routinized behavior for the recursive reproduction of action and structure in a very similar way as Giddens, both part company on the issue as to what extent these implicit, embodied forms of practical knowledge are still structured by social classes. Whereas theories of 'reflexive modernity' question this assumption more or less radically, Bourdieu's *habitus*-concept is still based on it. Even if the diagnosis of detraditionalization and flexibilization of modern life is true, from Bourdieu's point of view it does not change much about the fact that people from different social classes and milieus react in different ways to these trends. He is much more interested in the strategic positioning of actors in the field of symbolic struggles for economic, social and cultural capital. To take part in these strategic games, actors have to dispose of a 'practical sense' that allows them to understand the rules and the stakes of the game. It is the *habitus*, conceived of as the "embodied social structure," that provides and activates such necessary skills. Thereby, the concept of *habitus* is linked with the concept of 'social fields'.

> "A field is an arena of constant struggle for stakes, particular types of field specific and generic capitals. Struggles involve legitimizing the stakes themselves, thereby establishing what sorts of capital holding have what degree of value. The dynamics of a field (…) arise from the positions, dispositions, and position-taking of agents. That is to say, a field has structured positions, whose occupants typically have different resources and dispositions" (Warde 2004: 12).

Regarding sustainable consumption from this perspective directs attention to the dynamics of power relations in a given field of social practices (e.g., food), to the different kind and amount of 'capitals' actors (e.g., farmers, retailers, consumers) can dispose of, and to the symbolic struggles between different segments of producers, retailers and consumers on the question of how to define 'well-being', 'security', or 'quality' of goods and services. Any re-framing of stakes will bring about a devaluation of specific categories of products and services and a shift of power between different sectors of the economy.

These five points give a rough outline of the basic assumptions of modern social practice approaches. We will now turn to the empirical case study as a means of probing into the question as to what extent practice theory can provide a comprehensive theoretical framework for understanding the problems and dynamics of the transition to sustainability in the field of consumption practices. Specifically, we will take a look at the German *Agrarwende* ('turnaround' in agricultural policy), which was proclaimed in 2001 in reaction to the first German BSE-case.

How to Promote Organic Food Consumption: The Case of the German *Agrarwende*

In November 2000, the public was informed on the first case of mad cow disease (BSE) in Germany. This revealed the assurances of a BSE-free Germany, given time and again by the government and the agricultural lobby, as a myth. The media immediately took up the issue and reported in dramatic terms on BSE and the associated health risks. They also scandalized the negative side effects of modern, highly industrialized agriculture, which was blamed with enabling the spread of the disease by 'perverting natural processes' (e.g., by feeding bone meal to ruminant animals). The framing of the problem drew on the widespread unease in the German population regarding the extensive use of chemicals in agriculture, large-scale livestock farming handled by capitalized businesses and the contamination of food with pesticides, antibiotics and hormones.

Consumer uncertainty caused the beef market to collapse immediately. Between December 2000 and February 2001, about 50% of German households shifted their diets away from beef. The delay-tactics of the Ministry of Agriculture as well as the clumsy strategy of the Ministry of Health increased the pressure on politics to overcome the conventional policy structures in order to gain back public trust. Two months later, after both ministers had resigned, a newly structured Ministry of Consumer Protection, Food and Agriculture came into being. It was led by Renate Künast, a politician of the Green Party without ties to the agricultural establishment and its traditional clientele networks. The precautionary protection of consumers, the production of high quality food, and a multifunctional, sustainable agriculture became the new political paradigm, which was proclaimed – somewhat dramatically – as *Agrarwende*, a 'turnaround' in agricultural policy. A key element of the *Agrarwende* was the promotion of eco-farming to advance the small sector of organic food from a niche into a mass market. The ambitious target was increasing its market share from 3% to 20% within 10 years.

It was obvious that fiscal and legal instruments alone would not be sufficient to achieve this aim. Financial support programs would only be able to address farmers. Effectively implementing the political objectives, however, would require involving all actors along the food chain and motivating them to take part in the envisioned expansion of organic food markets. To this end, a mix of hard and soft policy instruments was employed. Opening the political arena to new actors (consumer rights organizations and NGOs, new advisory panels) and public campaigns to inform consumers were such soft measures. In addition, a new eco-label in accordance with EU standards (Bio-label) was introduced in September 2001.

What are the basic results of these measures on the different actors along the food chain from stable to table (see Brand 2006a, b)?[1]

1. The *Agrarwende* politics has altered the public perception of 'organic'. As a consequence, the market for organic products has gained momentum. Although demand temporarily returned to previously low levels once the hype surrounding organic-food during the BSE-debate had faded, the market is now growing by 10–20% annually since 2004. This growth trend seems to be quite robust (although it declined in 2009). Thus, the primary aim of the *Agrarwende* has been achieved: the eco-sector has been opened up to newcomers both on the supply as well as on the demand side. And supply has become more attractive: the variety of products has multiplied, not least in the convenience sector, which has experienced high growth rates across all segments of the food market.
2. The single most important factor driving the growing dynamics of the eco-market has been the introduction of the new official 'Bio' label. More than 55,000 products are now labeled with the eco-tag. It was introduced to put an end to the confusing variety of different eco-labels promoted by different organic farming associations and to guarantee a clear basic standard for eco-food. The decision to adopt the EU standard accommodated the interests of the conventional food

[1]These findings are based on a research project with the title "*Von der Agrarwende zur Konsumwende?*" (From a turnaround in agricultural policy to a turnaround in consumption patterns?) which ran from 2002 to 2006 and was funded by the Socio-Ecological Research Programme of the German Ministry of Education and Science.

trade industry, as it facilitated an internationalization of the eco-food market. For exactly this reason, it had been criticized by the long-standing actors of the organics-movement (Demeter, Bioland etc.), who promote their own eco-labels and feared that the new label would undermine eco-standards (established by their labels) and entail economic disadvantages.

3. The new dynamics of the bio-sector have led to fundamental changes in the German system of organic food provision. Traditionally, the sector has been characterized by two production and distribution chains: the ‘small, alternative chain’ for organics and the ‘large food chain’ of the conventional food industry. The former has grown since the 1970s (and earlier) out of ecological-alternative movements. It is mostly built on regional production and distribution networks and brings together producers, retailers and consumers based on holistic ecological ideas. This small organic food chain is complemented by various forms of direct marketing, which has a relatively high share of 25% especially in southern Germany. Since the 1990s, some supermarket chains of the conventional food sector have also started to develop their own eco-labels with a limited assortment and a rather small share of sales. The introduction of the new ’Bio’ label set a fundamental change in motion, which has led, even though with some delay, to a new entanglement of these segmented structures of the organic food market. Today, the formerly clear-cut boundaries between the conventional and the alternative sector of organic food provision have largely become blurred. The high growth rates of the bio-market and its comparatively high profit margins have attracted conventional retailers which had been totally disinterested in organic products until then, particularly the big German discounters (Aldi, Lidl etc.). This has reduced the prices for organic food and has taken new groups of consumers in who rarely bought organic products before. The growing appreciation of ’organics’ has also led to an increased growth of bio-supermarkets in the traditional, alternative food sector (within 5 years from about 90 to about 300); these have much larger sales space, a bigger product variety, especially of self-service products and display a modern sales atmosphere. Thus, the dynamics of the market for organics has mainly been fuelled by two developments: (a) discounters massively entering into the market and (b) the rapid expansion of the new eco-supermarkets.
4. The expansion of the bio-market has also had some adverse effects, particularly on farmers. On the one hand, the new ‘Bio’ label has opened the market for international suppliers who comply with the standards of this label. On the other hand, conventional retailers prefer big farms that can more easily provide larger units in standardized quality. Both aspects put the traditional, value-oriented small-scale structures of organic farming under pressure and force them to submit to the rules of the market implying more professionalism and specialization. Since the income of farmers, including organic farmers, will continue to depend on European agricultural policy, which is bound to further lower subsidies, it is not entirely surprising that the growing social appreciation of and demand for organic food is not accompanied by a similar expansion of organic farming. After a short stagnation in 2003/04 the share of organic farming is now rising at

a rate of about 5% per year. This remains far back behind the rapidly growing demand for organics, however. The gap is filled by foreign suppliers which in turn undermines the goal of strengthening regional food chains.

5. The *Agrarwende* thus has had ambivalent effects. The intended radical re-direction of farming towards sustainable agriculture has only partly been successful. The high growth rates of organic farming in the 1990s in the meantime have nearly come to a stop. The target of an eco-farming share of 20% remains in far distance. Contrary to this, the organic market has developed unexpected momentum, which, however, is forcing the organic-sector to adjust to the rules of the market and to adapt-to the structures of the conventional food business. This is raising substantial credibility problems for the value-based sector of organic farming. Whether this will be compensated for by the overall expansion of eco-consumption and the inclusion of new consumer groups who have formerly been put off by the ideological nature of green consumerism remains an open question.
6. It is also questionable whether the expansion of eco-consumption – resulting from lower prices, a more diverse supply and better availability of organic products in supermarkets – can already be considered as a clear shift towards sustainable food consumption. Whereas the *Agrarwende* was expected to lead to a higher recognition of both the ecological and animal-friendly effects of organic food production and its importance for rural development, nature protection, and landscape conservation and therefore to a higher willingness to pay for these additional qualities of locally produced, organic food, our interviews show that in most cases the awareness of these implications of local organic farming has neither increased nor have diets changed substantially. Rather, because of better availability and reduced prices, people have simply added some (more) organics (vegetables, dairy products etc.) to their menus, irrespective of their regional provenance. Paradoxically, this has been facilitated by the already existing positive image of organic products in the eyes of broad parts of the population — more than 50% of Germans count themselves to the group of ‘occasional buyers’ of organic food. Such products are perceived to be ‘somehow healthier’, ‘naturally grown’ or ‘less polluted’; organic farming is assumed to be more animal-benign and a practice associated with small-scale family farms set in a rural idyll. These imageries (whether true or not) support a general willingness to buy eco-food, if it can be easily incorporated into everyday routines. Whereas, on a symbolic level, it makes people feel better, it fails to suspend the ‘double commodity fetish’ (Cook and Crang 1996), which first erases consumer knowledge about the systems of food provision and then substitutes such knowledge by new signs and images (e.g., the fetish of rurality or locality) that create arbitrary symbolic worlds of food consumption. This does not per se favor a real *Agrarwende*.
7. The study also looked for factors that might disrupt diet routines and open them up for a more consistent pattern of eco-consumption by focusing on situations of biographical change, such as a child’s departure from home, change in partnerships, pregnancy and birth of children, relocation, illness, and retirement, or also a deep uncertainty caused by food scares (Brunner et al. 2006).

If routinized practices of consumption are questioned, for instance, by food scandals, illness, or an increased responsibility for the health of one's children, dominant factors like prices, convenience and routines lose their grip for a moment. The active search for new information becomes more important. Very often – although not always – this generates new opportunities for shifting towards eco-consumption. However, to make this happen, necessary information and context-specific support must be provided. Organic products must be offered in a sufficient variety and within reach, if possible in familiar stores. And they have to be available in restaurants, cafeterias, fast-food facilities, or staff canteens as well. Availability, convenience and 'normalization' are obviously also a crucial precondition for the dissemination of new patterns of (organic) food consumption in cases of a disruptive deroutinization of food practices.

Change of Consumption Patterns: What Practice Theories can Explain and What They Cannot

Without doubt, the food domain displays some characteristics that are different from those in the domains of housing or mobility, which depend to a much higher degree on infrastructural and technical systems of provision. Nevertheless, the change in diet from conventional to organic food is not much different from strategic consumption decisions in other domains. The outlined case study thus can provide some general insights into the problems and dynamics of governed social changes toward sustainable consumption. We can identify seven critical thresholds or pre-conditions for a successful process of sustainability transition:

1. A scandalizing or dramatizing media discourse that undermines the trust in established institutional routines (drawing on already existing diffuse criticisms of these practices in large parts of the population) and disrupts consumption habits at least for some time.
2. Politics are put under pressure to react and to restore trust by introducing new ways of problem solving (not only on a symbolic level).
3. The existence of alternative (niche) practices that bear the potential to substitute the dominant institutional regimes, at least in part, if they are politically supported in a more consistent manner.
4. The formation of new discourse coalitions and of new political, economic, and social alliances that have the power to enforce new institutional practices or regimes.
5. The societal 'fit' of the political measures taken. This is an intricate problem as the chosen measures (regulation, financial incentives, information strategies, participatory forms of governance etc.) do not only have to fit into the 'rationales' and routines of the groups concerned, especially of those who can be expected to profit from the planned changes; such measures also face fierce resistance on the part of those groups who are in danger of losing influence and power in the course of reorganization of the respective field of practices. The intended

changes of social and institutional practices, therefore, have to be supported by a highly visible public campaign directed at ensuring the legitimacy of the political measures adopted.

6. The 'fit' of new goods, services or infrastructural opportunities with the everyday practices consumers engage in. Whether politically supported patterns of pro-environmental behavior fit into the context of everyday life not only depends on their resonance with class- or milieu-specific lifestyles, but also on macro-structural developments that change the character of everyday practices. Structural trends like individualization or the growing flexibilization of work life reduce, for instance, the importance of cooking and eating together in family life and speed up the spread of convenience food (even in the organic sector). These trends run counter to the objective of promoting small regional production chains with a low degree of food processing, though most (German) consumers highly esteem regional products.
7. As the example of the German *Agrarwende* shows, neither the reaction of economic actors nor that of consumers can be planned in detail. In the case of the *Agrarwende,* nobody could foresee that the big discounters – traditionally the counterparts of the value-based organic food sector – would enter the eco-market on a large scale, thus triggering a restructuring of the whole system of organic food provision in Germany with a lot of unintended side-effects. As the ubiquity of such side effects is a systemic consequence of interventions into complex systems, sustainability policies demand institutionalized reflexive mechanisms that enable a periodical assessment of what has been achieved and how targets and instruments can be adjusted (Voß et al. 2006). Obviously, it is rather difficult to institutionalize such long-term reflexive mechanisms in modern democracies.[2] Party competition, the conflictuality of societal interests, the breathlessness and medialization of modern politics are severe constraints to this kind of institutional innovation. Thus, the *Agrarwende* program was no longer an issue in Germany once the current government came into office in November 2005, even though some elements of these policies (revaluation of consumer politics, shift towards a 'multifunctional agriculture' etc.) were kept in place.

In accordance with practice theory, Fig. 13.1 provides a systematic account of the key analytical dimensions (and their interrelations) that we have so far identified as influencing the advancement of sustainable consumption. It points (1) to the interaction between the "everyday life of consumers" and the "systems of provision" in shaping consumption patterns, which are themselves part of an integrated set of social practices that structure social life in the various domains (housing, food, clothing, transport, education etc.). In each of these fields, the actors involved struggle for field-specific stakes, for better access to and having disposal of economic, social and cultural capital. While the inner core area of field-specific practices represents the primary object of research on consumption from a practice theory perspective, the case study shows that the dynamics of these struggles and

[2] The Dutch approach of a long-term 'transition management' is a rare exception.

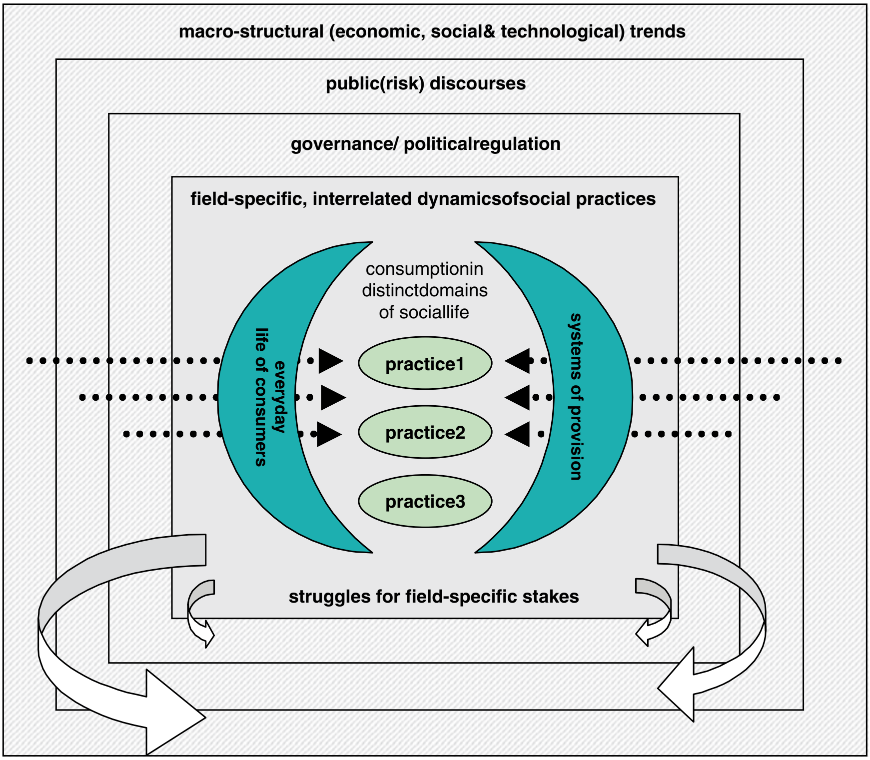

Fig. 13.1 Context model of promoting sustainable consumption (own model based on Spaargaren 2004: 17)

the related changes in social practices and consumption patterns are (2) decisively influenced by further context factors. These can be analytically discerned as the levels of ‘political regulation’, ‘public discourse’, and ‘macrostructural trends’. All of these factors or levels of influence are closely interrelated.

What is the advantage of adopting a practice approach in studying the problems of sustainable consumption? The benefits of this approach – and of the, in most cases, related ethnographic research methodology – are most evident in its ability to identify the systematic links of social, economic, technical and cultural developments involved in the emergence, stabilization and change of social practices. The approach underlines the fact that a perspective centered on individual consumption decisions – and the cognitions, attitudes, motives and emotions involved therein – fails to get an adequate grasp on opportunities and problems of changing consumption patterns. Rather, consumption behavior must be viewed as embedded in various domain-specific sets of social practices and as developing in concert with the structures that determine production and supply by way of complex recursive loops. It is influenced by changes in technical infrastructure and supply networks just as it is affected by changes in household and family patterns, in the world of work and the structure of income distribution, by shifts in cultural standards and prevailing value systems, by public debates on risk issues and political regulation. Although practice approaches indeed incorporate most of these factors in empirical research, they mostly do this from a micro-sociological perspective, focused on how these various elements interact in producing and reproducing daily routines.

This is an unnecessary restriction. Drawing on Giddens' structuration theory, the micro-sociological focus of practice theory could be easily extended to an analysis of structural links between daily consumption practices and systems of provision, as the studies by Southerton et al. (2004) or Spaargaren (2004, 2006) show. Following Warde (2004), Bourdieu's approach could also be used as a helpful theoretical toolkit for studying the dynamics of social practices that arise from the struggle of competing collective actors in the various fields of consumption (see above). Yet, up to now, the practice theory approach has not really borne fruit at the structural level.

As to the *Agrarwende* study, practice theory seems to be well suited for reconstructing changes in the practices of individual groups of actors, such as organic farmers, retailers and consumers, in reaction to a changing environment. It has much more problems in getting a grasp on the political dynamics of the public BSE discourse and on the market dynamics of organic food triggered by the introduction of the 'Bio' label. In general, neither public discourses nor questions of systems (e.g., market) dynamics and problems of governance receive much attention in practice approaches. This seems to be a consequence of the analytical emphasis on routinized everyday practices. Retaining the benefits of practice theory's comprehensive approach in analyzing consumption practices while not losing sight of the impact of structural dynamics requires opening up the analytical framework of practice theory for a more systematic consideration of the interrelation between micro- and macro-sociological processes.

Giddens and Bourdieu provide basic theoretical tools for such a venture that could be further refined by linking practice approaches with other bodies of social sustainability research. Adjustments to this end should be easiest in case of discourse-theoretical approaches. Theories addressing the institutional logic of economic and political practices also show considerable potential for linking them with practice theories. There remains a last theoretical challenge: In light of the growing significance of globalization and novel, complexly interwoven globalizing and localizing dynamics, chain and network approaches are gaining crucial importance in research on sustainable consumption. Accordingly, practice theories must be systematically connected with research on commodity chains (Gerefi and Korzeniewicz 1994), on systems of provision (Fine 2002; Fine and Leopold 1993) or on global networks and environmental flows (Mol and Spaargaren 2004) if they are to live up to their promise of being able to identify opportunities for change in consumption patterns rooted in the recursive relation of structural dynamics and everyday practices. What conceptual advancements this would imply and whether such demands may require adjustments that extend beyond the limits of practice theory are issues yet to be debated.

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Chapter 14
(Im)mobility and Environment–Society Relations: Arguments for and Against the 'Mobilisation' of Environmental Sociology

Henrike Rau

Abstract Physical (im)mobility is central to many interactions between human society and the biophysical world. The chapter presents arguments for and against the 'mobilisation' of environmental sociology. Drawing on Urry's (2000, 2007) 'new mobilities paradigm', it asks how such a 'mobility turn' might affect the conceptual and methodological focus of this sub-discipline, including its ability to challenge more conventional, anthropocentric approaches to sociological theory and research. It argues that a preoccupation with mobility, while beneficial in many ways, can eclipse more 'static' (or at any rate more 'a-mobile') influences on social life such as the continued impact of national political institutions on citizens' social and physical (im)mobility and the regulation of social-environmental change. Environmental sociology, a field of inquiry committed to the systematic study of environment-society relations, seems ideally positioned to address some of these mobility issues, and in turn benefit from sociological approaches that take mobility seriously.

Keywords Mobility • Immobility • Inter- and transdisciplinarity • Mobility turn • Environmental sociology

Introduction

In recent years physical mobility has gained considerable prominence as a topic in social theory and research. This 'mobility turn' coincided with a heightened interest among many sociologists in the growing interconnectedness of the world brought about by technologies and the rapidly changing social, political and material conditions associated with globalisation. Although globalisation remains a contested concept that captures diverse trends, many commentators recognise the worldwide

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circulation of people, goods and information as one of its central characteristics. Some prominent sociologists have thus argued for a paradigm shift in the social sciences to advance the analysis of these global flows (Cresswell 2006; Urry 2007). They maintain that sociological inquiry in the twenty-first century can no longer remain pre-occupied with more static units of analysis such as societies and nation-states (Bauman 2000; Urry 2000, 2007). According to Cresswell and Uteng (2008: 1), "the understanding of 'mobilities' has offered a cohesive way of viewing the highly globalised/mobilised world we inhabit today."

Recent efforts to bring about a 'mobility turn' in sociology (and cognate disciplines) have presented considerable challenges, which partly relate to the disciplinary division of labour in the social sciences. Traditionally, human spatial practices in general and physical mobility in particular have been considered the domain of geographers, town planners and engineers. Sociologists have hitherto paid little attention to the social and cultural causes and consequences of (increased) physical mobility and changes in mobility patterns, including daily commuting and car dependency (Rammler 1999; Rau 2009). While recent inter- and transdisciplinary studies have successfully attempted to address some of these gaps,[1] transport sociology remains a niche subject within sociology.

Physical (im)mobility is also central to many interactions between human society and the biophysical world. Environmental sociologists' contributions to the globalisation debate have more or less explicitly focused on specific (im)mobilities, including the governance of global social and material flows and the emergence of global environmental movements (e.g., Macnaghten and Urry 1998; Spargaaren et al. 2006; Rootes 2007; Khoo and Rau 2009). Others have highlighted the environmental threats arising from late modern mobility practices and instances of 'hypermobility', most notably in the form of rapidly increasing greenhouse gas emissions from the transport sector (e.g., Brenck et al. 2007). For example, greenhouse gas emissions from the Irish transport sector increased by 160% between 1990 and 2005, with transport being responsible for almost 20% of Ireland's overall emissions (ICCC 2006).

This chapter presents arguments for and against the 'mobilisation' of environmental sociology. Drawing on Urry's (2000, 2007) 'new mobilities paradigm', which gained considerable recognition among social scientists in the UK and Europe (but perhaps less so outside Europe), it asks how such a 'mobility turn' might affect the conceptual and methodological focus of this sub-discipline, including its ability to challenge more conventional, anthropocentric approaches to sociological theory and research. It argues that a preoccupation with mobility, while beneficial in many ways, can eclipse more 'static' (or at any rate more 'a-mobile') influences on social life such as the continued impact of national political institutions on citizens' social and physical (im)mobility and the regulation of social-environmental change. Environmental sociology, a discipline committed to the systematic study of

[1] See, for example, *SceneSusTech*, a cross-national collaborative project on car transport systems and mobility patterns in European cities to explore scenarios for a sustainable society. Fieldwork for this project was carried out in the late 1990s and early 2000s in Dublin, Athens, Bologna and Helsinki (see Wickham 2006 for a more detailed description of the project).

environment-society relations, seems ideally positioned to address some of these mobility issues, and in turn benefit from sociological approaches that take mobility seriously.

Section 2 provides a brief overview of the recent ‘mobilisation of sociology’, focusing in particular on some of the contributions made by classical social thinkers like Simmel and their impact on Urry’s new mobilities paradigm. To demonstrate the potential benefits and drawbacks of a ‘mobilisation’ of environmental sociology, the chapter then critically examines three central claims associated with the new mobilities paradigm (and the ‘mobility turn’ more generally). First, the view is rehearsed that proposals to ‘mobilise’ social theory and research and develop a ‘sociology beyond societies’ challenge more traditional perspectives that place the nation-state at the centre of social inquiry. Given that many of today’s environmental problems and measures transgress the boundaries of nation-states, they should arguably be scrutinised through the lens of mobility rather than through more static tools for social research and analysis. This is not to imply, as some critics have claimed, that spatiality itself has been consistently neglected during the history of sociology. Secondly, the chapter critically assesses the notion of society as a system of mobile human and non-human actors, which is a cornerstone of Urry’s mobilities approach. Here, the inclusion of inanimate objects (e.g., ICTs, mobility devices) challenges more conventional sociological perspectives based on an anthropocentric perception of the relationship between people, technology and the environment. This view ties in with the critique of ‘human exemptionalism’ at the core of environmental sociology (Catton and Dunlap 1978; Williams 2007). Part five of this chapter engages with Urry’s controversial claim that the mobilities paradigm is post-disciplinary. What are the benefits and drawbacks of a post-disciplinary, eclectic paradigm that borrows from a range of different, perhaps even contradictory theoretical sources? Can this claim to post-disciplinarity be reconciled with recent calls for greater transdisciplinarity in other areas of environmental and sustainability research?

The concluding section of the chapter proposes to link the investigation of global (im)mobilities to questions of environmental (in)justice, thereby tapping into a well established field in environmental sociology and maximising the benefits of ‘mobilisation’. There is ample evidence to suggest that people without economic and political bargaining power have to shoulder a disproportionate amount of the social-environmental burden of mobility. Environmental risks such as those associated with car dependency often have a disproportionate effect on people who cannot afford to protect themselves against them. The routing of motorways and relief roads through areas inhabited by the less well off serves as a reminder that the distribution of mobility-related environmental risks is rarely “democratic” (Beck 1992) but reflects the hierarchy of social inequality. Similarly, adaptation strategies vary hugely depending on people’s economic and political status. Here, it is argued that well established concepts in environmental sociology such as environmental justice and ‘just sustainability’ (Agyeman et al. 2003) must be expanded to cover mobility-related tensions and imbalances. Introducing the concept of ‘just mobility’ into environmental sociological thinking might advance the analysis of pressing social and environmental problems, thereby strengthening the contribution of environmental sociology to current sustainability debates.

(Re)discovering Spatiality in a Globalised World: Steps Towards the 'Mobilisation' of Sociology

Key sociological theories of globalisation consider the reorganisation of space (and time) to be central aspects of the 'great transformation' of human society in the twentieth and twenty-first century. Giddens (1990) links modernity to the development of transport and communication technologies that enable people to transcend existing temporal and spatial boundaries and maintain social relationships across ever-larger distances (*time-space-distantiation*). Harvey (1989) coined the term 'time-space compression' to describe people's experiences of a shrinking world. Urry (2007) proposes to analyse the global reorganisation of time-space *through the lens of mobility*, thereby capturing the circulation and flows of people, goods and symbols and ideas across the globe (see also Hannam et al. 2006). His new mobilities paradigm promotes a post-disciplinary 'sociology beyond societies' which synthesises classical and contemporary work on a range of mobility-related themes, including migration, vagabondage and virtual travel.

The spatial mobilisation and disembedding of social life associated with modernisation and globalisation have evoked mixed reactions from sociologists and members of the public. While some commentators view increased mobility as a sign of progress, freedom and the success of the 'project of modernity,' others criticise the involuntary nature of many instances of mobility that curtails people's freedom to choose to be immobile (Benhabib and Resnik 2009). Yet others concentrate on immobility as a form of resistance to the social ills and environmental destruction arising from 'hypermobility' (Adams 1999).

Urry's mobilities paradigm captures this ambiguity. On the one hand, he associates increased mobility with opportunities for intercultural exchange and the emergence of a global level of human agency. On the other hand, he highlights the unintended and chaotic aspects of (hyper)mobility, including the environmentally destructive and socially and politically disruptive dependency on fossil fuel. He argues that control over (certain aspects of) nature is central to most mobility efforts, which come to bear on social relations. Sociological analyses of the system of automobility illustrate how social relations are reflected in and shaped by the materialities of the biophysical world (e.g., fossil fuel, space, road infrastructure) as well as culture-specific ideas about the relationship between society and nature. Researching mobility-systems, therefore, offers ample opportunity to study environment-society relations and the 'taming of nature' and their increasing globalisation. According to Urry (2007: 13) "nature gets dramatically and systematically 'mobilized'" as part of the modernisation process.

Given the centrality of space in many of these contributions to the study of modernisation and globalisation, critics' claims that sociology has largely ignored spatial phenomena, and continues to do so, seem rather spurious. In fact, the lasting influence of classical sociology on the study of space and mobility cannot be underestimated, and often goes beyond the boundaries of the discipline. For example, an entire section of Urry's book *Mobilities* (Urry, 2007) is dedicated to Georg Simmel's mobility-centred work which 'provides the framework for this book by referring to most issues and topics to be examined' (p. 26). Simmel's essays *The Metropolis and Mental Life* (1997b [1903]) and *The Alpine Journey* (1997a [1895]), amongst others, serve as reminders of the importance of space-society relations in classical sociology. At the same time, they reveal the environmental consequences of modern socio-spatial practices such as leisure tourism and the commodification of the landscape, as is exemplified by Simmel's critique of "the wholesale opening-up [*of the Alps*] and enjoyment of nature" (1997a [1895]: 219) afforded by the construction of Swiss railway links.

Similarly, prominent instances of social anthropological community studies reveal an in-depth engagement with issues of space, place, identity and the environment (e.g., Arensberg and Kimball 2001 [1940], including the introduction to the third edition by A. Byrne, R. Edmondson and T. Varley). We also need to acknowledge the contributions made by human ecologists to the analysis of socio-spatial phenomena, which aimed to reveal the consequences of modernisation, urbanisation and migration for social relations and the organisation of space. Park's (1967 [1925]) essay *The Mind of the Hobo: Reflections upon the Relation between Mentality and Locomotion* is indicative of the strong interest among human ecologists at the Chicago School of Sociology in the 1920s and 1930s in physical mobility and the study of rural and urban society-environment-interactions.

> It is in locomotion, also, that the peculiar type of organization that we call 'social' develops. The characteristic of a social organism – if we may call it an organism – is the fact that it is made up of individuals capable of independent locomotion … It is this fact of locomotion … that defines the very nature of society. (Park 1967 [1925]: 157–159)

In the second half of the twentieth century, Sennet (1991 [1977]), Lefebvre (1991 [1974]) and Castells (1996) all made substantive contributions to the sociology of space and mobility, albeit from very different theoretical and ideological standpoints. Their work covers, among many other things, mobility-related aspects of city life, including car ownership and use as well as the impact of transport infrastructure development on urban and social fabric.

Overall, there is ample evidence that the spatiality of human social behaviour, including the growing mobilisation of people, objects and ideas as part of the modernisation process, received considerable attention in classical sociology. Contemporary sociological studies of space and mobility continue to challenge more established sociological ways of thinking about 'the social' as detached from the physical environment by emphasising the inherent materiality of (im)mobilities. Recent proposals for a 'mobility turn' and a paradigmatic shift towards 'a sociology beyond society' thus promise to advance a strand of research which has environment-society relations at its heart. This chapter will now focus on three key characteristics of Urry's new mobilities paradigm, namely its challenge to nation-state thinking, its conceptual integration of non-human actors and its post-disciplinary eclecticism, to further examine its potential use for environmental sociology.

Porous Borders, Impregnable Boundaries: Mobility, Citizenship and the Nation-State

The development of sociology in the nineteenth century coincided with the rise of the modern nation-state as key political and administrative unit in many parts of Europe. As a result, thinking about society in terms of national identity and territory has been a central element of the sociological project, at least until the second half of the twentieth century. However, increased labour mobility, forced and voluntary migration and global material flows (e.g., resources, hazardous waste and other environmental risks) have challenged these beliefs. The introduction of 'globalisation' as a major theoretical concept in sociology in the 1970s called into question conventional notions of 'society' as a spatially defined entity that provides its members with a sense of place and a set of identity-defining institutions. Similarly, the emergence of environmental sociology as a sub-discipline in the 1970s drew attention to the global nature of many ecological problems and the interconnectedness of environmental movements around the world.

New concepts of 'society' as culturally heterogeneous, mobile and cosmopolitan emerged in mainstream sociological thinking, which reflected the growing international interdependence brought about by technological innovation and related changes in temporal and spatial practices (Castells 1996; Beck and Sznaider 2006; Urry 1999, 2007). The question whether and to what extent nation-states and governments could retain power in the face of this increasing global interdependence became the subject of intense debate among sociologists.[2] Urry (2007) argues that states are losing their ability to use legal frameworks and physical coercion to regulate the mobilities of their citizens. Instead, attempts by state actors to control global flows and cyberspace through the use of surveillance and anti-terrorism legislation have become more widespread. Intercepting and screening email and telephone conversations of (environmental) activists are part of the repertoire of measures used to control the mobility of citizens in a globalised world.

Some commentators have rejected claims by contemporary sociologists that classical sociology has been too pre-occupied with the nation-state and that the concepts, methodologies and terminology used by social thinkers such as Marx, Weber, Durkheim and Simmel are largely irrelevant in the context of current debates on globalisation and cosmopolitanism (Turner 2006). Instead, these authors argue that some of the ideas of the early sociologists could be re-visited while admitting that there may limitations to the applicability of certain concepts outside the realm of the nation-state. As Turner (2006: 146) observes,

[2] The well-publicised globalisation debate at the London School of Economics and Political Science between Leslie Sklair and Anthony Giddens captures some of these issues (LSE 2001). Excerpts from the debate can be found at http://www.fathom.com/course/10701014/index.html.

> To employ the notion of citizenship outside the confines of the nation-state is to distort the meaning of the term, indeed to render it meaningless. […] some terms are properly national and must remain so. There are limits to the idea of 'sociology beyond societies' because some concepts are inherently not mobile, but necessarily fixed and specific. It does not follow that they are useless; it merely signifies that some institutions cannot become global […].

Proponents of this perspective maintain that national institutions and governments still have a substantial role to play and that nation-states continue to exert considerable power, in particular with regard to controlling the flows of people, goods and capital (Ray 2002; Turner 2007). They would argue that notions of 'flexible citizenship' (Ong 1999) or 'global citizenship' based on cosmopolitanism and lifestyle politics (Carter 2001) are misleading because citizenship tends to resist 'mobilisation'.

However, this standpoint is challenged by the overwhelming amount of evidence that many of today's social, economic and environmental problems simply cannot be solved at the national level. Nation-states are losing their autonomy in crucial areas such as banking and finance, market regulation, migration and environmental protection. While a shift in sovereignty from the national to the supranational may be deliberate, as in the case of EU membership, it can create new and unintended interdependencies both within and between individual states. More importantly, it is argued here that economic, political and socio-cultural changes of the kind witnessed during the onset of the global economic recession in 2008 produce *material outcomes* which remain poorly understood and which environmental sociologists need to focus on. Those who argue that the 'era of the nation-state' has been superseded by a new phase of 'capitalism without boundaries and frontiers' also remind us that this 'footloose' and disembodied global economic system remains highly carbon-dependent and wedded to the logic of industrialism and economic growth, thereby producing previously unknown global environmental threats (e.g., climate change). For example, Giddens (1990) observes that the (over) exploitation of natural resources constitutes a key driver behind the processes of modernisation. A 'mobility turn' in the social sciences would draw further attention to the crucial role of material flows in the emergence of global economic systems and their effects on society and the environment.

In summary, social scientists are increasingly calling for a re-conceptualisation of society as a network or system of mobilities, a trend which appears to be most pronounced in the English-speaking parts of Europe. John Urry's new mobilities paradigm challenges conventional ideas of society as static and territorially bound. The 'mobilisation' of social analysis and research offers a promising new direction for the investigation of global social and ecological threats such as anthropogenic climate change because of its critical stance on the nation-state (and other static spatial entities such as the neighbourhood) as primary unit of analysis. The next section focuses on how the mobilities paradigm challenges anthropocentric views of social relations by focusing on non-human actors in various systems of mobilities, including resource and waste streams that shape environment-society relations globally.

Actors, Actants and Hybrids: The Materiality of Environment-Society Relations

As stated above, mobility-centred social research tends to emphasise the materiality of economic and socio-environmental relations, thereby critiquing post-modern globalisation theories that posit the dematerialisation of social life. For example, the consequences of human (auto)mobility for rural and urban social and physical environments dominate much social scientific work on transport patterns, modal choice and sustainability policies (e.g., Whitelegg 1997; Kaufmann 2000). According to Urry (2004: 26), the system of automobility constitutes 'the single most important cause of environmental resource-use'. This emphasis on resource use and material flows, inanimate objects, technologies and waste products clearly challenges conventional approaches to social theory and research that see the study of material realities as beyond the remit of sociology. A focus on mobilities thus provides opportunities to (re)define environment-society relations and investigate their social and material outcomes in depth.

Many existing studies of 'mobile' social relations reveal the complex interplay between human actors, inanimate objects (e.g., cars, bicycles) and the wider physical environment; however, the nature of these relationships frequently remains under-theorised. Urry's mobilities paradigm aims to address this gap by advancing the concept of *hybridisation*, that is, the notion of human agency as the product of interactions between people and objects. His catalogue of 'new mobile rules for sociological method' includes a commitment to treating 'things as social facts' and to 'see agency as stemming from the mutual intersections of objects and peoples' (2007: 9). The concept of the 'car-driver' expresses this complex, two-way relationship between people and their cars which defines automobility as a socio-spatial practice and which recognises that inanimate gadgets and technologies influence social practices and vice versa.

Theoretical proposals regarding the role of non-human actors in social relations, some of which actually ascribe agency to inanimate objects, have been subject to considerable debate in environmental sociology since the 1980s. Actor-network theory (ANT), an approach to network analysis developed by Bruno Latour and others, is perhaps one of the most prominent attempts to redefine environment-society relations (e.g., Law and Hassard 1999; Latour 2005). ANT draws on theoretical and empirical contributions from European and North American sciences and technology studies (STS) to make visible both the materiality and meanings of networks and their recreation or 'performance' through everyday practice. While its concept of agency as the product of associational links between human and non-human actors (also known as *actants*) remains controversial to date, ANT has been a major influence on European environmental sociology. Urry's mobilities research draws on fundamental elements of ANT, notably the notion of actants, but shifts the focus on to mobilities that constitute and maintain these hybrid networks of people and technologies.

> […] technologies do not derive directly and uniquely from human intentions and actions. They are intricately interconnected with machines, texts, objects and other technologies (Michael 1996). […] there are no purified *social* structures as such, only hybrids (Latour 1993). (Urry 2000: 33, emphasis in original)

The centrality of the concept of hybridity is arguably a key strength of the mobilities paradigm that makes it attractive to social scientists interested in environment-society relations. It is argued that the study of socio-technical networks (e.g., automobility, public transport) and their environmental consequences could be advanced through more holistic, problem-focused and theoretically informed mobility research that moves beyond current concerns with the sustainability of particular transport options or technical solutions. The following section asks how arguments put forward by Urry and others that the social scientific investigation of diverse mobilities needs to move beyond disciplinary boundaries could be connected to recent calls by environmental sociologists and sustainability researchers for more transdisciplinary research.

Beyond Disciplinary Boundaries? Transdisciplinarity, Post-disciplinarity and the Use of 'Mobile Methods'

Until recently the study of transport and mobility was considered the domain of engineers, town planners, geographers and economists, not sociologists. As a result, the consequences of increased mobility for society and the environment and the social implications of unequal access to mobility opportunities received little attention in transport research and policy. The development of a coherent sub-discipline that could synthesise and advance existing instances of 'mobile' social theory and research thus remained a distant goal for many decades. More recently, however, there has been a marked increase in interest in mobility as socio-spatial practice that significantly affects the transition to sustainability (Buhr et al. 1999; Kaufmann 2000; Schöller et al. 2007). This raises a number of interesting methodological questions regarding how to do social research on mobility issues and whether existing disciplinary boundaries help or hinder the process.

Calls for transdisciplinarity in environmental sociology and sustainability research are often met with considerable confusion regarding the scope and meanings of such an approach. According to Hadorn et al. (2008: 3), transdisciplinarity attempts to address the gap between 'knowledge production in academia, and knowledge requests for solving societal problems.' This definition hints at some core issues that are central to many debates on disciplinary divisions and the relationship between scientific expertise and practical know-how (cf. Fischer 2000). Firstly, it suggests that knowledge production in the academic realm needs to focus more on mitigating practical problems, such as poverty and environmental degradation. Is it possible to provide answers to today's pressing social and ecological problems through research that connects theory and practice across different disciplines and fields? Secondly, it suggests the democratisation of scientific knowledge production to give greater prominence to local knowledge and lay expertise. But who decides what counts as useful knowledge or 'expertise'? Transdisciplinarity also involves many problems over and above the involvement of non-academic actors and problems in themselves. Commenting on calls by Gore or Tickell to new forms of thinking in connection with the environment, Edmondson (2008) shows that 'wise' forms of environmental debate involve blends of ethical, social, political and cognitive arguing which might conventionally be held to transgress the bounds of everyday academic disciplines. While a detailed discussion of these issues is beyond the scope of this chapter, a brief examination of recent instances of inter- and transdisciplinary mobilities research can add further nuance to the debate.

Researching the multi-facetted nature of physical mobility requires innovative theoretical and methodological frameworks that merge input from different disciplines. Recent seminal publications in transport sociology and policy studies reveal the scope and breadth of existing empirical and conceptual work (Buhr et al. 1999; Vigar 2002; Schöller et al. 2007). While the practical nature and policy relevance of many mobility issues has clearly pushed the field towards more applied inter- and transdisciplinary transportation research, we can also identify a number of conceptual issues which have received attention. For example, there is a growing body of social and political science research on access, mobility and social inclusion (e.g., Hine and Mitchell 2003; Kaufmann et al. 2004; Rau and Hennessy 2009) and the potential role of virtual mobility tools and options in addressing existing exclusionary patterns (e.g., Kenyon et al. 2003). This said, recent claims that social and political science research has entered an era of post-disciplinarity need to be treated with some scepticism given the persistence of (sub-)disciplinary divisions in mainstream transport and mobilities research.

Urry (2007) proposes a number of steps towards the 'mobilisation' of social theory and research. As regards the theoretical framework, his new mobilities paradigm draws on a range of different theoretical suppositions, including Simmel's essays on the metropolis, Bauman's work on state-society relations, Latour's Actor-Network Theory and aspects of Luhmann's systems theory. In fact, he describes his mobilities paradigm as 'post-disciplinary' and 'eclectic', which has attracted considerable criticism from some commentators. Nevertheless it can be argued that his commitment to a 'sociology beyond society' is clearly rooted in his long-standing conviction that one of sociology's main strength lies in its ability to be 'parasitic' and to scavenge from other, more reductionist disciplines (cf. Urry 1981).

> Sociology seeks understanding of the nature of our social life, how social connections face-to-face and at a distance are contingently enabled and performed. And it does this through scavenging from insights and approaches thrown up/out elsewhere especially revealing the material worlds which social life both depends upon and iteratively reproduces. (Urry 2005: 1.9).

The resulting *assemblage* of different theoretical fragments and approaches vividly illustrates the interconnectedness of sociological thinking and its links with other disciplines; it also reflects Urry's critical stance on rigid (sub)disciplinary divisions.

> [A]lthough I am a fan of inter- and trans-disciplinary studies, these must be based upon strong and coherent disciplines. There is nothing worse than a lowest common denominator interdisciplinarity. But there is also little worse than a discipline seeking to erect boundaries around something that cannot be bounded, trying to pull up the drawbridge when there is

> little 'essence' left within the castle. […] sociology has prospered and grown especially through drawing upon and providing a space of contestation and debate between elements often extruded from other more reductionist disciplines […*sociology is*] more a field or perhaps a network and less organised through hierarchy. (Urry 2005: 1.2–1.3)

On the other hand, Urry's theoretical synthesisation efforts produce considerable tensions and contradictions that cannot always be satisfactorily resolved and that occasionally appear to present a barrier to the integration of different strands of theory and meaningful empirical research. For example, we can detect strong leanings towards 'systems-thinking' in some of Urry's publications on automobility, including references to Luhmann's definition of autopoiesis and to path-dependency, coercion, non-linearity, complex systems change and tipping points.

> Automobility can be conceptualized as a self-organizing, autopoietic, non-linear system that spreads world-wide. […] Automobility is thus a system that *coerces* people into an intense *flexibility*. It forces people to juggle fragments of time so as to deal with the temporal and spatial constraints that it itself generates. […] The car is the literal 'iron cage' of modernity, motorized, moving and domestic. (Urry 2004: 27, emphasis in original).

This coincides with the use of biological and organicist metaphors such as 'viral spread' and 'contagion' to describe the non-linear development of the car system in the nineteenth and twentieth century and its constraining effects on human mobility. This contrasts with other aspects of Urry's mobility-related work where he focuses on the formation of networks and the fluidity of social relations vis-à-vis human-technology-hybrids, thereby emphasising the role of human agency in the creation of the 'system of automobility'. Overall, Urry's mobilities approach seems to oscillate between an emphasis on structures and systems and a strong focus on performativity, complexity and agency. No doubt this reflects the fact that human societies *are* composed in part of structures and systems but still allow some room for human agency, but the mobilities approach alone may not identify which is dominant, in what ways, in particular instances. Thus translating it into workable designs for empirical research may present challenges which call for further work.

In relation to research methodology and practice for the investigation of (im) mobilities, Urry proposes a number of 'mobile methods' that are 'on the move' and that address some of the weaknesses of more conventional forms of sociological inquiry and engagement, including their inability to deal with highly fluid, fleeting and dispersed socio-spatial phenomena and their lack of interest in material contexts of human behaviour (see also Büscher and Urry 2009). These new tools for social research include covert and overt observation of people's movement, recordings of corporeal and virtual mobilities, mobile ethnography and participant observation (e.g., 'walking with' methodology) and the collection of time-space diaries. For example, the *Habitable Cars* project carried out by Laurier et al. (2008) deployed such a 'mobile method'; their 'driving with' methodology involved video recordings of the inside of the car by participants and members of the research team. These recordings were then analysed to document the inhabitation of the car by family members and to capture people's mobility behaviour.

In conclusion, the mobilities paradigm provides for a radical departure from more conventional approaches to sociological theory and research. This presents a number of advantages, including greater flexibility and openness to social research 'beyond disciplinary boundaries'. On the other hand, the adoption of a post-disciplinary, eclectic theoretical framework throws up new challenges and difficulties for problem-oriented transdisciplinary empirical research. For example, it may not always be easy to translate complex theoretical concepts, such as those presented by Urry (2007), into workable designs for empirical mobilities research. While the use of 'mobile methods' offers some new and innovative strategies for data collection and analysis, their deployment raises a number of methodological and epistemological issues. Is it possible to engage in post-disciplinary empirical research and, if so, what might such an approach look like? What unit of analysis is most appropriate for a particular type of mobilities research? Can the adoption of a critical realist stance help mitigate tensions between realist and constructivist perspectives? Are these different perspectives necessarily connected to specific approaches to data collection and analysis, such as positivist, interpretivist or multi-method designs? These and other questions have yet to be satisfactorily addressed before a post-disciplinary framework for 'mobile' social research can be advocated for adoption in environmental sociology and transdisciplinary sustainability research.

(Im)mobilities, (In)equality and the Politics of Sustainable Development

In a globalised world characterised by hypermobility, complex economic, technological and cultural interdependencies and widening gaps in wealth, social and physical mobility become closely intertwined. This concluding section of the chapter argues that mobility-focused social-environmental theory and research needs to capture and critically examine this relationship between (im)mobility and (in)equality and its environmental outcomes, much more so than is currently the case. It makes the case that the sociological study of global (im)mobilities and environmental (in)justice presents itself as a prime area in which the 'mobilisation' of environmental sociology could be advanced. Mobility opportunities need to be understood as an important resource whose distribution can act as a powerful catalyst for social-environmental change, for better or for worse. The question how to achieve a just and fair distribution of actual and potential socio-spatial mobility without risking environmental degradation needs to be central to a 'mobilised' environmental sociology and sustainability research agenda.

Urry's new mobilities paradigm aims to address the consequences of '[…] too little movement for some or too much for others or of the wrong sort or at the wrong time' (Urry 2007: 6). He maintains that 'analysing […] mobilities involves examining many consequences for different people and places that can [*be*] said to be in the fast and slow lanes of social life. There is a proliferation of places, technologies and 'gates' that enhance the mobilities of some and reinforce the immobilities of others' (2007: 11). Interactions between spatial mobility and social standing also produce complex socio-environmental outcomes, which may reduce or exacerbate inequalities in society. For example, labour mobility, that is, people's ability to change location in search for employment, has become a key factor with regard to social mobility. At the same time, it has enormous consequences for the geographical distribution of people and resources, energy consumption, urbanisation rates and transport patterns, to name but a few. Similar observations can be made in relation to individualised (auto)mobility, car dependency and long-distance commuting.

The interrelationship between physical (im)mobility and social (dis)advantage is captured in Kaufmann et al.'s (2004) notion of 'motility', that is the capacity for socio-spatial mobility, which they consider as a form of capital. Urry (2007) draws on Kaufmann et al.'s work and deploys the Bourdieuan concepts of habitus and field to formulate his theory of network capital. He suggests that 'mobilities develop into a distinct field with characteristic struggles, tastes and habituses […] which gives rise to an emergent form of capital, network capital, that is a prerequisite to living in the rich 'north' of contemporary capitalism' (2007: 196). Urry uses the term 'kinetic elites' to describe privileged groups in society whose movement is largely unrestricted by economic and political conditions and whose member can avail of network capital. This contrasts with less powerful social groups whose ability to move is severely restricted and whose quality of life, health and economic security is reduced by the mobility options of others.

People's ability to move around is almost always subject to political intervention by the state and other interested parties, including corporations and employers, which may or may not have a common goal. For example, the incarceration of suspected and actual offenders illustrates the state's ability to immobilise its citizens. Similarly, the regulation of cross-border migration frequently reflects insurmountable tensions between the needs of the global economy for a mobile workforce and attempts by nation-states to retain power and monitor and control the movements of their citizens (Turner 2007). Growing numbers of environmental refugees who suffer displacement due to climate change and other ecological threats are likely to exacerbate these tensions.

On the other hand, states often encourage certain types of intra-national mobility, for example through the provision of transport infrastructure. The motorway as a symbol of political and military power, economic progress and freedom has been a central feature of modern nation-building. Similarly, the development of civil aviation after WWII was a major step towards the mobilisation of people and goods. More recently, supranational political entities have come to play an increasingly important role in regulating people's physical mobility, thereby influencing socio-economic opportunities and barriers. In a European context, the impact of the EU on labour and geographical mobility has been significant. In fact, freedom of movement between member-states has been one of the main goals of the European project since its inception, bringing with it the physical mobilisation of a large proportion of the European polity and the transformation of politics. This said, many mobility-related social and environmental issues remain subject to more conventional multi-level governance processes at local, national and supranational level.

Politics and technological innovation are key driving forces behind the mobilisation of people, objects and ideas. Urry (2004: 33) recognises the politics of automobility as a key factor pushing the current unsustainable car system towards a tipping point. In his opinion, it takes a set of interdependent changes in the political and social fabric of world society, occurring in a particular sequence, to transform today's locked-in car system into a post-car system. But what changes in environment-society relations might tip the system into a new path? According to Urry (2004), a reduction in mankind's dependency on non-renewable resources might be instrumental in the transformation of the current car system. This will be complemented by steps towards de-privatisation and 'virtualisation' of cars and car use and the replacing of predict-and-provide-models in transport planning with demand-reduction strategies. It could be argued that these changes indicate a broader transformation of the relationship between environment and society, which hinges on the idea of mobility as a public good or shared resource that requires redistributive policies.

But technological and policy changes alone are unlikely to make the current car system more sustainable. Mobility is also governed by social norms and rules that are shared, negotiated and internalised and that may help or hinder the transition to more sustainable mobility patterns. For example, the relative unpopularity of public transport vis-à-vis the private car that is prevalent in many developed countries could be seen as indicative of a modern ideology based on liberalism and (economic) individualism. On the other hand, the emergence of gendered mobilities suggests that mobility patterns can both reflect and shape a group's status in society (cf. Grieco et al. 1989; Cresswell and Uteng 2008).

To summarise, mobility-centred research in the social sciences implies a theoretical and empirical re-engagement, across different disciplines, with the social, political and environmental processes that regulate the mobility of people, goods and ideas. The unequal distribution of both mobility opportunities and social and environmental risks associated with hypermobility and car dependency in many European countries illustrates the link between environmental justice and mobility. Social research aimed at informing sustainable mobility policies needs to be cognisant of this connection, much more so than is currently the case. The introduction of the concept of 'just mobility' into environmental sociological thinking might help advance the analysis of these pressing social and environmental problems and strengthen sociology's contribution to current sustainability debates.

Conclusions: Towards a 'Mobility Turn' in Environmental Sociology?

The desire to clearly demarcate 'the social' from 'nature' has been central to the endeavours of many classical thinkers, albeit perhaps less so than is commonly assumed. Calls for a departure from classical ways of thinking made by proponents of a mobility-centred 'sociology beyond society' provide opportunities to reverse some of the conceptual divisions that hamper an improved sociological understanding of environment-society relations. This chapter identified three key features of Urry's new mobilities paradigm – the rejection of concepts of 'society-as-nation-state', the conceptual integration of human and non-human actors and an eclecticist approach to theory-building that moves beyond disciplinary divisions – as possible key points of contact for the 'mobilisation' of environmental sociology.

Overall, proposals for a mobility-centred 'sociology beyond societies' appear to offer a useful alternative framework for analysing environment-society relations and their socio-cultural and technological causes and consequences. There are, however, some noticeable weaknesses that require attention. First and foremost, it is important to recognise the contradictions that are likely to emerge from an eclecticist approach to social theory formation which characterises the new mobilities paradigm. Attempts to reconcile classical sociological thinking (Simmel) and more recent post-structuralist and systems and networks approaches (Foucault, Latour) inevitably produce new tensions with regard to the structure-agency dilemma or debates concerning the role of intentionality in the performance of everyday social life. Ascribing agency to non-human actors, a prominent feature of Latour's Actor-Network approach that has also influenced mobilities thinking, has been steeped in controversy and seems irreconcilable with more anthropocentric notions of human agency that dominate mainstream sociological thinking. On the other hand, broadening the concept of agency to include relations between humans, other living beings as well as inanimate objects seems to afford opportunities for a more eco-centric, mobility-focused interpretation of environment-society relations.

The role of technology as a key enabler of corporeal and virtual mobility deserves particular attention by environmental sociologists, in particular because of its complex materialities and their influence on people, place and wider society. This is reflected in the complex socio-environmental consequences of car dependency and 'hyper-mobility' in urban and rural areas in Ireland and elsewhere. Problem-oriented transdisciplinary research on transport and mobility offers opportunities for further mobility-focused theoretical work in environmental sociology and sustainable research that moves well beyond more conventional, static concepts of environment-society relations.

Finally, it seems important to further expand the scope of the new mobilities paradigm to take cognisance of global and local political processes and power relations that bring mobility opportunities for some and lack of access and immobility for others. While many of these political processes appear to attest the relative powerlessness of locally embedded social actors in a rapidly mobilising world, they also show the continuous power of territorially bound nation-states vis-à-vis supra-national and global political and economic players. An improved understanding of how global flows of people, materials and information come to be regulated by various political actors thus seems to be a useful addition to the analysis of global environmental problems, including the growing number of environmental refugees. Calls for equal access and a fair and just distribution of mobility opportunities thus tie in with broader questions of environmental justice and attempts to promote just sustainability policies. It is here that we can expect the greatest benefits arising from a 'mobilisation' of environmental sociology.

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Part IV
Ecological Adaptation Policies and Social Experimentation

Chapter 15
Environmental Sustainability as Challenge for Media and Journalism

Heinz Bonfadelli

Abstract Ecology and sustainability became important issues in the mass media and the public sphere, but environmental and risk communication remain a fragmented and still somewhat marginal topic in communication research. In the first theoretical part of this contribution, relevant research questions and important underlying theoretical perspectives like news values, issue attention cycles, media framing or bias and various media effects approaches like agenda-setting, knowledge gaps and cultivation processes are discussed, whereas empirical data are presented from a study, analyzing press coverage of sustainability in Switzerland on the basis of a standardized quantitative content analysis.

Keywords Sustainability • Environment • Communication • Journalism • Mass media

Introduction

Since the 1970s, *environment* and *ecology* became more and more important issues in the mass media and the public sphere of most developed western societies, especially since the Brundtland Report (1987), the Rio Conference (1992) and the Kyoto Protocol (1997). Subsequently, empirical communication research started to deal with the topic "environment and media," firstly in the Anglo-American area (Stamm 1972; Schoenfeld et al. 1979; LaMay and Dennis 1991; Dunwoody and Peters 1992; Hansen 1993; Anderson 1997; Cox 2006), later in Germany (Krämer 1986; Thorbrietz 1987; Hömberg 1995; deHaan 1995; Brand et al. 1997; Michelsen and Godemann 2005; Dernbach 2005) and with delay in Switzerland as well (Meier 1993a, b; Rey 1995;

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Zierhofer 1998; Eisner et al. 2003). However, "media and environment" remains a *marginal research area* and the contributions from communication science have been *fragmentary* up to now. An added complexity is, that the topic "environmental communication" is located in the interface of further research domains like "risk communication" (Dunwoody and Peters 1992; Bonfadelli 2004b), "science communication" (Lewenstein 1995; Kohring 1997) and "communication of disasters" (Walters et al. 1989), and therefore cannot be differentiated clearly enough.

From the *perspective of mass communication science* one can ask *three main research questions*, each related to one of its main research areas:

- **Media and Journalists.** What kind of media resources are underlying and which kind of journalistic routines and role definitions are guiding environmental journalism (e.g., Anderson 1991; Siegerist 1997)? Do the media function as claims-maker in the definition and construction of the environment as an urgent social problem? What normative expectations have been formulated towards media? And how do public relations activities influence media as gatekeepers (e.g., Rossmann 1993)?
- **Media and Coverage.** How important is journalistic coverage of environmental problems? How did environmental coverage develop over time, in a quantitative, but qualitative way as well? And in a comparative way: Are there differences between countries? Furthermore, what aspects of the wider issue "environment and ecology" on the one hand and the journalistic routines or media frames on the other hand have been important (e.g., Schoenfeld et al. 1979; Meier 1993a, b; Lewis 2000; Eisner et al. 2003)?
- **Publics and Media Effects.** Besides the question of media resonance by environmental problems and agenda setting for environmental issues (e.g., Ader 1995; Newig 2004), there is the problem of how media audiences are reacting towards the increasing media coverage of environmental problems (e.g. Stamm et al. 2000). Did the media succeed in creating a more sensible public, in enhancing environmental awareness (e.g., Riffe 2006; Shanahan et al. 1997) and in stimulating more ecological behaviors of the wider public (Holbert et al. 2001)?

Especially the questions concerning the *normative expectations* towards media and journalists (Thorbrietz 1987: 300) as well concerning ecologically relevant media effects (Bonfadelli 2004a) have been debated controversially, not least in the media itself. As an example, the Swiss elite newspaper Neue Zürcher Zeitung asked in its issue from the 4th of October 1994: "Media, not a medium for environmental issues? Diagnosis of an unbalanced communication". In view of the fact, that environmental coverage is strongly dominated by sudden and unexpected environmental catastrophes like the breakdowns in nuclear reactors of Three Mile Island (1979) and Tschernobyl (1986), chemical accidents like Seveso (1976), Bhopal (1984) or Schweizerhalle in Basel, Switzerland (1986), as well as lingering or sudden environmental catastrophes like the forest dying in Europe and the changing climate or flood catastrophes or BSE and SARS, as well as risks of new technologies like genetic engineering or nanotechnology etc. There is certainly the question, if coverage of environmental problems is able to inform or even activate the broader public, or if modern mass media will stay fixed towards information flooding and scaremongering and environmental journalism will go on paralyzing the environmental consciousness as a consequence, instead of being a loudspeaker for environmental concern, educating people and triggering change (Stocking and Leonard 1990; Major and Atwood 2004).

Environment, Ecology, Sustainability as Societal Issues

Issues of environment, ecology and sustainability are *not only scientific phenomena* in the strict sense that they can be defined "objectively" and measured in reliable ways that permits the more or less direct translation into well based policy decisions and concrete environmental actions with specific and measurable outcomes. Rather, environment in general and sustainability in particular are *shared resources* and *collective phenomena* in the form of a *social problem that is defined and constructed socially* (Schoenfeld et al. 1979; Hansen 1991). The environment is a collectively shared resource with a limited character. Because natural resources are finite and unlimited growth therefore is not possible, sustainable strategies in using and exploiting nature and environment are essential. At the same time, the natural environment is such a complex system that it can be controlled by humans only in a very limited way, as the public discussions about risky environmental phenomena like the depletion of the ozone layer or the warming up climate demonstrate. Furthermore, environmental pollution is in most cases *not directly visible*, and scientific observations, reliable measurements and hard data have to be *communicated, discussed and legitimized in the public sphere* and also *judged in relation to social values* and ideas of desired strategies of sustainable development. Finally, undesired and risky environmental pollution on the one hand, and exemplary ecological and sustainable strategies on the other hand, have to be *communicated actively* by *scientific experts* and *advocacy groups* to politicians and lay people by mass media or by public communication campaigns (Bonfadelli 1993). Because environment cannot speak for itself, there must be societal actors like Greenpeace or WWF (Anderson 1991; Rossmann 1993), and engaged journalists (Siegerist 1997) that function actively as popularizing agents and advocates for environmental concerns. As a consequence, the same objective environmental pollution values or data demonstrating climate change can be discussed and judged in completely different ways depending, e.g., on the economic situation of a country (first vs. third world), the political constellation (US vs. Europe), or the corresponding media system (commercialized vs. public broadcasting).

These specific and complex facets of "environment" as a *natural phenomenon* and even more as a *societal issue* (Schoenfeld et al. 1979) have unfortunately impeding consequences for environmental journalism. The complex concept of sustainability is a so called *cross-sectional media topic*, because it has in a time dimension references to the past and to the future as well; then there are technical, economical and societal causes and consequences involved. Contrary to this, media coverage is structured by the principle of resort (beat); as a consequence environmental issues can be placed into the public affairs, the economics and the local section or the science pages of a newspaper. But these *journalistic routines* usually will function as communication barriers (Hömberg 1993; Anderson 1997: 45ff.), above all because journalists working in the local or political section of a newspaper normally don't have the necessary background knowledge to deal with complex scientific matters like sustainability issues.

Research Questions and Theoretical Perspectives

How journalists get their stories and how media select from the unlimited universe of events is a central question of communication research. In a *constructivist perspective* media do not simply mirror the real world on a one to one basis. Instead journalism processes and simplifies the complexity of the real world on the basis of its own *media specific logic* (Schulz 1989; Luhmann 1996). As a result not every issue has the same chance to be selected for media coverage.

Gatekeeping and News Values

Media function as *gate keepers,* and the theory of news values (Schulz 1976; Staab 1990) explains selection of newsworthy events on the basis of a set of *internalized journalistic rules* and programs that journalists acquire during the process of socialization and rule taking in the newsrooms of the media. These interpersonally shared codes establish a common basis for journalism as a profession. Important *news values* are immediacy (time dimension), proximity (space dimension), prominence of a person, an organization or a country (social dimension) and surprise or continuity, but oddity, drama, conflict, negativity and consequence (object dimension). In addition, as a consequence of *growing commercialization of media*, the orientation towards media audiences has increased and thus is promoting trends like personalization, emotionalization, dramatization, and staging of events, but scandalizing as well. These journalistic trends can be summarized under the label of *infotainment*. In the sphere of environmental journalism, news values like "surprise" combined with "negativity" and "harm", together with emotionalization and scandalization focus media coverage towards unforeseen and sudden erupting catastrophes of nature or technological incidents. Whereas lingering environmental pollution like deployment of the ozone layer, the human made climate change and the reduction of the variety of species or long term risks as consequences of new technologies like nuclear energy or biotechnology barley enter the media agenda. This is especially true for the complex and at the same time abstract concept of sustainability.

Issue Attention Cycles

News value based gate keeping processes by journalists and media, together with communication activities by governments and NGOs result into so called *issue attention cycles* of media coverage (Downs 1972; Newig 2004; Nisbet and Huge 2006). As a consequence of triggering key events like protests or scandals, certain issues that have been discussed at the beginning only by experts and specialized media on a low level of intensity, get in a next phase into the focus of popular media. By increasing and intensifying media coverage over a certain time span an issue becomes more and more prominent in the public sphere and is moving into the center of the public's attention. In communication research this process is called *agenda-setting* (Atwater et al. 1985; Ader 1995; Eisner et al. 2003): The *intensity of mass media coverage of an issue* will enhance its salience not only for the public but for politicians as well. In particular, the political system can be forced by intensive media coverage to react and to start dealing with the (environmental) problem being defined as urgent by the media (Newig 2004). In a next phase of the issue attention cycle, the social problem, now legitimized, will be moved over into the administrative system and media attention will probably decrease and / or will be displaced by new upcoming social issues.

This *up-and-down of the issue attention cycle* is well documented e.g. in the case of the career of the issue "forest dying" in Switzerland (Zierhofer 1998), Germany (Newig 2004) or Norway (Roll-Hansen 1994). An *intensifying public debate of ecology and environmentalism* was documented and analyzed by Eisner et al. (2003: 58) on a broader and more representative basis by systematic content analyses of the Swiss press since the early 1970s with a peak in the mid 1980s; this trend in media coverage was partly stimulated by processes of intensifying political protest activities of the so called "green" movement; together this resulted with a certain delay in problem solving political activities of the Swiss parliament.

If mass media take up a certain social problem like *climate change* and define it in the public sphere as urgent by intensifying media coverage (see Fig. 15.1) and creating an issues cycle (Brossard et al. 2004), this is influenced and mediated by the involved social actors in the different *public arenas of politics, economy or science.* Here they act as problem promoters, adversaries or experts, trying to interpret and position the issue based on the own perspective (Rucht 1994). These processes of social meaning construction are analyzed in communication research namely within the perspective of media framing.

Processes of Media Framing

The concept of media framing (Reese et al. 2001; Dunwoody 1992; Bonfadelli 2002; Dahinden 2006) is based on the constructivist assumption that journalists and media interpret social reality in general and environmental problems in particular always from a certain standpoint insofar a particular problem definition and a

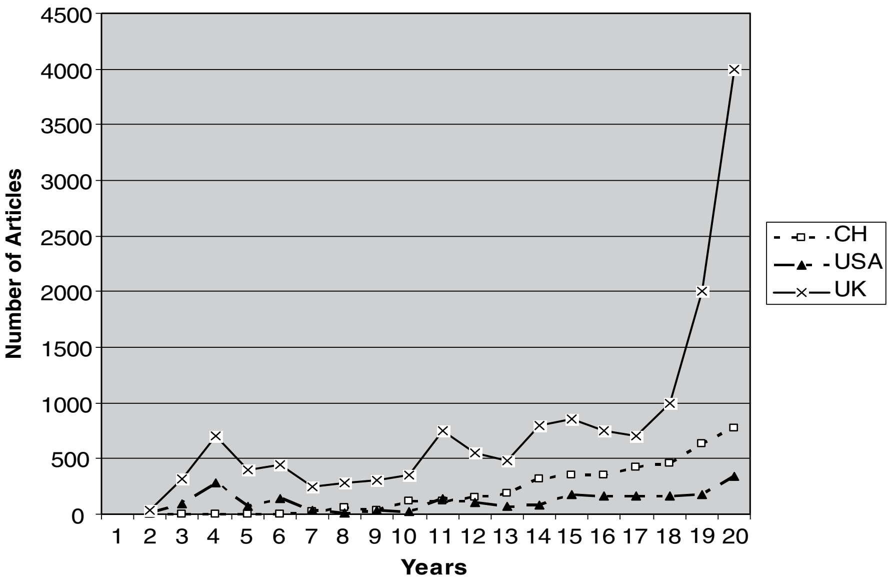

Fig. 15.1 Media attention cycle for ”climate“ issue in the press of Switzerland, UK, and the US. Note: Trends from 1988 to 2006; number of articles per year, additive for three newspapers in Switzerland (own data), six newspapers for the US and three for UK (Boykoff 2007a)

corresponding context is given by processes of selection, emphasis, exclusion, and elaboration. “To frame is to select some aspects of a perceived reality and make them more salient in a communication text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation (Entman 1993: 53). Based on a content analysis of media coverage of three social problems, Kensicki (2004) e.g. could demonstrate that (a) the industry was named in 75% of the press articles as *perpetrator* of air pollution; (b) but *consequences* of air pollution were only a topic in 40% of the articles; (c) in addition the government was cited in 75% of the articles as responsible for *possible solutions*; but possible solutions for the problems were absent in almost all of the articles. Based on their own content analysis, Major and Atwood (2004: 8) therefore, summarize environmental journalism in the U.S.: “Environmental stories define problems, not solutions“. In environmental communication, framing analysis has been applied so far e.g. to media coverage of nuclear energy (Gamson and Modigliani 1989), genetic engineering (Bonfadelli et al. 2007) or climate change (Trumbo 1996; McComas and Shanahan 1999). In both cases several positive frames have been identified like (a) *technological progress* or (b) *economic prospect*, but also negatively connotated frames like (c) *pandora’s box*, meaning unknown and uncontrollable risks, (d) *runaway*, meaning fatalism after the innovation, (e) public accountability, meaning call for public control and regulatory mechanisms, or (f) ethical, meaning calling upon ethical principles, as well. These frames shifted according to the intensity of the political debate and the constellation of the involved actors.

Media Bias

The German media researcher Kepplinger (1989) points after all in his *theory of instrumental actualization* on the function, that media not only select and interpret issues but also provide evaluations of politics and judgements of politicians. This happens especially in situations of conflict where the involved actors interpret reality in antagonistic ways. He demonstrates on the basis of content analyses how media coverage can be biased for or against a certain issue. This is done mostly not by direct judgements but by citations of favorite experts approving the position of media and journalists (e.g., Roll-Hansen 1994). This process can be interpreted either as media framing or as distortion of reality, depending on ones own constructivist or objectivist meta-perspective (Schulz 1989). Of particular importance is the underlying *role interpretation of an (environmental) journalist*, e.g. as neutral information transmitter (Boykoff and Boykoff 2004), as responsible educator of the public or as investigative and critical reporter. Moreover, constraints of commercial media are contributing indirectly to bias in environmental journalism by undermining criticism (e.g., Roll-Hansen 1994; Anderson 1997: 54ff.).

Media Effects: Agenda-Setting, Knowledge Gaps, Cultivation of Reality

Several theoretical approaches in the media effects tradition (Bryant and Zillmann 2002; Bonfadelli 2004a) analyze the consequences, especially of environmental journalism on the perceptions, attitudes and behaviors in the domain of environment. Media effects always require that media in general are used and environmental topics in the media are recognized and attended by media audiences. Up-do-date figures from audience research demonstrate e.g. (Bonfadelli 2007), that 46% of the Swiss population are strongly or even very strongly interested in “environment and ecology” as media topics; the figure is even higher in the segment with college education (52%) or within the politically interested audience (69%).

One of the most important research perspectives is certainly the *agenda-setting theory.* It is hypothesized that the intensity of media coverage of an issue correlates with the perceived issue salience by the public. So, journalist’s daily news decisions and the media selection of topics do significantly influence the audience’s picture of the world as a long term cognitive media effect. The evidence of agenda-setting theory comes from a combination of content analyses on the one hand and survey data on the other hand, namely based on longitudinal research designs with several measurements in time. Comparable representative survey data from Switzerland together with the content analytic data provided by Eisner et al. (2003: 50) indicate a parallel decline on the one hand of "environment and ecology" as prominent media topics and on the other hand a weakened perception of "environmental pollution" as an important problem: While 74% of the population named "environmental protection" an important problem in 1988, only 7% did so in 2006!

Knowledge gap perspective (Bonfadelli 1994) analyzes not only the relations between the agenda of the media and the public but concentrates furthermore on the process of information diffusion by media into the society. The original hypothesis postulates: When the flow of information into a society increases segments with higher education and/or higher social status will acquire media information at a faster rate, and as a consequence, gaps in knowledge between the different segments in society will increase. So, not all media users will profit in the same way from available media information e.g. about climate change. Especially higher educated publics, using information rich print media on a daily basis, being better linked to interpersonal networks, and having more background knowledge, will learn more efficiently from environmental information provided by the media.

Bonfadelli (2005) and Bonfadelli and Bauer (2002) e.g. analyzed existing knowledge gaps in the field of the controversially discussed genetic engineering, demonstrating knowledge gaps between European countries, based on educational structure, intensity of conflict and media coverage, on the one hand and knowledge gaps within countries, based on individual level of education, topic relevance or print media exposure on the other hand.

And finally, *cultivation analysis* focuses on television as the most important source of broadly shared social images. The mainstream medium television functions as common symbolic environment into which children are socialized from beginning on. Based on a wide range of content analyses, cultivation theory is hypothesizing that heavy viewers in comparison with light viewers will develop distorted perceptions of reality consonant to televisions most dominant messages. Shanahan (1993), Shanahan et al. (1997) and Shanahan and McComas (1999) demonstrated that heavy viewers in the US had less environmental knowledge and were less willing to engage for environmental concerns. Another study realized by Holbert et al. (2001) demonstrated however that viewing of television news and nature documentaries has the potential to enhance sensitiveness for ecological issues. On the basis of Eurobarometer data Schulz (2003) could also demonstrate that mass media and especially television are important sources for environmental information. As a consequence, media use correlated – but only weakly – with levels of environmental knowledge, even when controlled for third factors (age, sex, education). And this was expressed also in the personal concerns about the state of the environment. The Swiss sociologist Kriesi (2001: 53) is arguing in a similar direction on the basis of a field experiment with press articles dealing with environmental problems. He emphasizes that media have stimulated wide spread learning effects in relation to environmental pollution. But these effects turned out to be selective, reverse and not very precise. In his opinion, media alone are not able to change opinions, especially not in form of specific and intended effects into a certain direction.

Media Based Evidence from Switzerland

In the second part of this contribution empirical data are presented and discussed from an empirical study analyzing press coverage of sustainability in Switzerland on the basis of a standardized quantitative content analysis. The main goal of the study was first to find out in a quantitative way, if sustainability is an important topic on the media agenda today, and second how the Swiss press is covering this issue in a qualitative perspective. Here, we wanted to describe and analyze more precisely what thematic frames journalists are using, when dealing with questions of ecological sustainability.

Müller and Strausak (2005) coded and analyzed 1,002 articles published in three newspapers with high circulation in the Zürich region: “Blick”, the only tabloid paper in the German part of Switzerland, “Tages-Anzeiger” (TA) the leading forum paper in the Zürich region, and the “Neue Zürcher Zeitung” (NZZ), the leading elite paper in the German part of Switzerland. The sample was based on a preliminary study with the goal to identify all articles published between 1993 and 2004. This was done electronically with the search term of sustainability. This resulted in 11,342 articles published in the NZZ, 5’104 for the TA and only 304 articles for the boulevard paper Blick. This means that 3.4 articles per issue in the NZZ and 1.5 article in one issue of the Tages-Anzeiger contained an explicit reference to the term “sustainability”,[1] whereas sustainability could be found in only one out of ten issues of the tabloid paper Blick.

3.4 articles per issue dealt with the topic of sustainability in the elite paper “Neue Zürcher Zeitung” and 1.5 articles per issue have been published in the forum paper “Tages-Anzeiger”; but sustainability was a topic only in one out of ten issues of the tabloid paper “Blick”.

In a second step, a probability subsample of 1,002 articles were selected for a more detailed quantitative content analysis. The process of selection revealed that in only 336 articles or in one third of the original sample, at least two dimensions of the five core dimensions of the “sustainability” concept had been highlighted, namely: (1) relations to the present or the future generations, (2) north-south conflict, (3) relations to society, (4) relations to environment, or (5) relations to economy. These core dimensions of the sustainability concept are articulated on the semantic level in pairs of terms like sustainable development, sustainable utilization, sustainable energies, and sustainable products or to cultivate in sustainable ways. However, in two thirds of the articles, the labels “sustainable” or “sustainability” were used only in a very superficial way and without any deeper conceptual links to the core concept like sustainable effect or impact, to change in a sustainable way, to improve sustainable etc.[2] Contrary to other more precise terms like ecology,

[1] The articles have been identified with the term “sustainability” or “sustainable” (in German: Nachhaltigkeit/nachhaltig) in the electronic archives of the newspapers.

[2] In German: nachhaltig beeinflussen, nachhaltige Wirkung, nachhaltig verändern, nachhaltig prägen, nachhaltig verbessern etc.

environmental protection, climate change, ozone layer etc., the German terms "nachhaltig" or "Nachhaltigkeit"[3] are semantically much more open and can be used to point to very different things, that may not have any commonality with the field of ecology. This lack of clarity over the basic concept and the absence of clear distinctions operate as barriers in the public sustainability discourse at least in the German language.

Development of Media Coverage in Time

The computerized search in the electronic media archives of the two newspapers "Neue Zürcher Zeitung" and "Tages-Anzeiger" with the key term "sustainability" in the wider sense (Fig. 15.2) as well as the quantitative content analysis of our subsample of articles covering questions of sustainability in the narrow sense (42% of the total sample) reveals an increase of media coverage over time, reaching a maximum with the Conference of Johannesburg in 2002. The resonance of the issue "sustainability" thus has increased in the last ten years since the Rio-Conference significantly.

Themes in Media Coverage of "Sustainability"

The term "sustainability" was used in the narrow sense in 595 cases. In addition it was coded in a second step, which of the five dimensions of sustainability stood in the center of the article. In 29% of the cases, societal and social question were

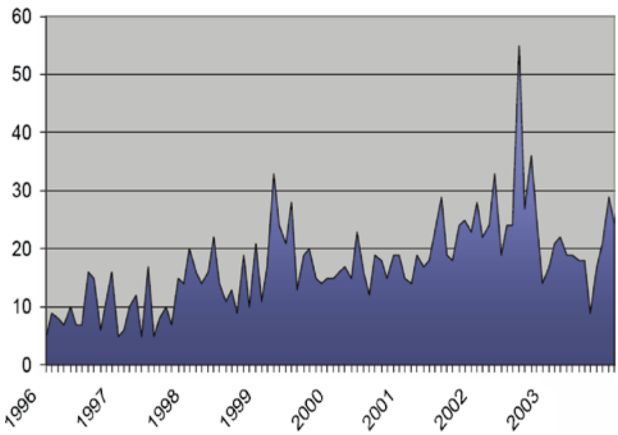

Fig. 15.2 Development of "sustainability" as media issue over time (number of articles). Note: Number of articles per month in the two newspapers "Neue Zürcher Zeitung" and "Tages-Anzeiger"

[3] In English: sustainable or sustainability.

discussed over the whole period, followed by economical questions with 26%. An ecological focus was evident in another 19% of the cases, whereas the dimension of space, the cleavage between north and south, was discussed only in 15% of the cases, and the dimension of time, that means, the further development and its consequences for future generations, was a topic only in 11% of the cases.

The trend analysis demonstrates certain shifts insofar social and societal aspects of the sustainability debate increased in importance over time, whereas the dimensions of "ecology" and "time" lost of relevance. The intermedia comparison reveals that there is a tendency in the elite paper "Neue Zürcher Zeitung" to discuss economical aspects of the sustainability concept with priority, followed by political questions, whereas political questions of the sustainability debate have priority in the forum paper "Tages-Anzeiger", and economical and cultural themes follow. And sustainability is a topic especially in human interest stories in the popular tabloid "Blick".

Single topics and controversial issues concerning sustainability were measured in the content analysis in more details, linked especially to the three main components of the sustainability concept, namely ecology, society and economy. There are typical constellations marked in a three dimensional map (Fig. 15.3): Questions of natural resources were discussed by the media in the context of environment, whereas questions of mobility, city development, and planning are discussed in the context of societal regulation. In contrast, developmental issues of the third world, and problems of agriculture are discussed in the press together with economic questions.

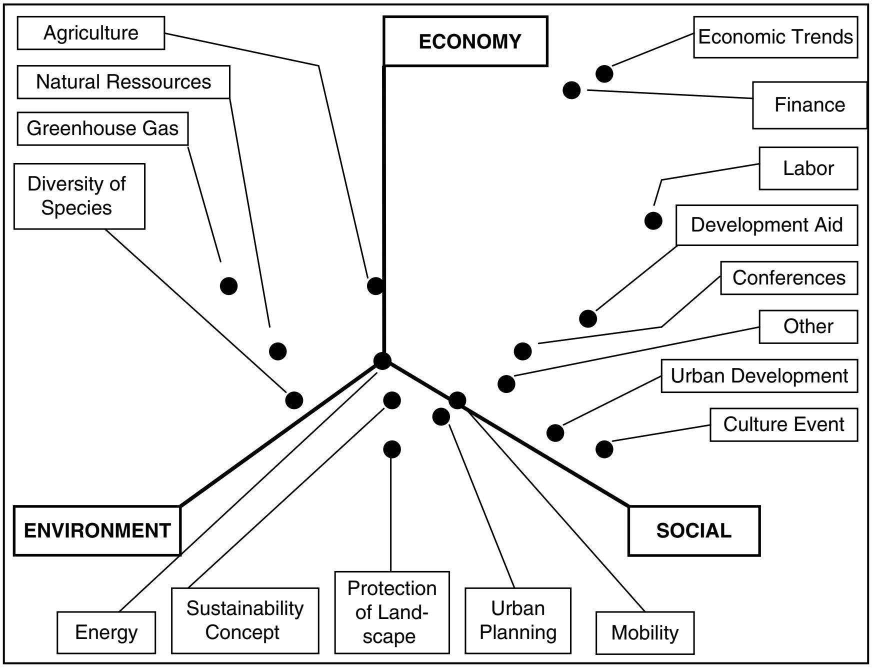

Fig. 15.3 Positions of single topics in the three main areas of sustainability

Societal Actors and Spaces

An analysis of the prominent actors, ordered in relation to various sectors of society, demonstrates that *politicians and political institutions dominate the sustainability discourse* with a share of almost 50% in the coverage of the two quality papers "Neue Zürcher Zeitung" and "Tages-Anzeiger". The most cited names are those of Swiss politicians like the Moritz Leuenberger, the federal minister responsible for the energy, traffic and communications department, Adolf Ogi, a former federal minister and president for the Swiss Olympic Winter Games candidacy, Eugen David, a member of parliament and of the conservative Swiss Populist Party SVP, Bruno Frick as representative of SwissSolar, Philippe Roche the director of the Federal Environmental Agency or Rosmarie Bär a member of parliament from the Green Party and the representative from the critical Swiss Energy Foundation. It is a peculiarity of the sustainability discourse, that there is no single person or representative of an organization or party, that stands out, instead there are many single names, organizations or institutions dealing with questions of sustainability. This lack of one or a few outstanding and highly visible charismatic international or national figures is certainly a weak point of the sustainability discourse.

An additional *comparison between parties* indicates that the small Green Party with a voter share of only just over five percent dominates the media discourse with 18%, whereas the Christian Peoples Party CVP is present with a share of 24% that equals almost its parliamentary position of 23%; interestingly the Swiss Social Democrat Party SP has a weaker media stance with 19% in comparison with its position in the parliament of 24%; the more rightist parties like the Liberal Democratic Party FDP and the conservative Swiss Peoples Party SVP, where environmental questions have only minor or almost no priority, have a correspondingly weak position of 22% or 13% in the media sustainability discourse, contrary to the respective party strengths of 28% and 20%.

Furthermore, Fig. 15.4 indicates in a *spatial dimension* the very strong concentration of the sustainability press discourse to domestic issues of Switzerland on the

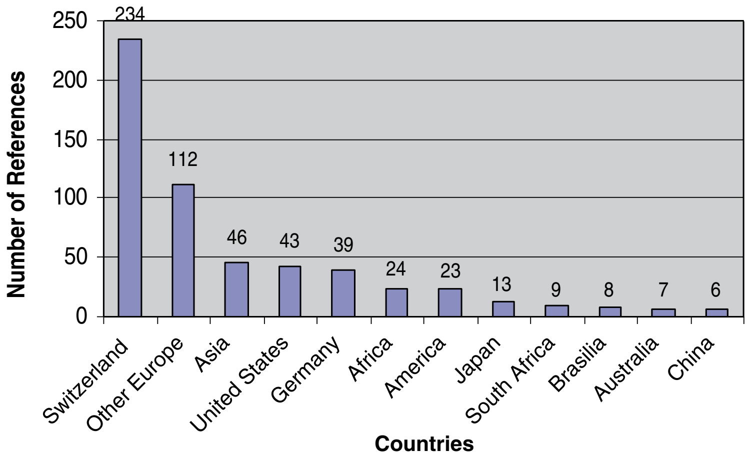

Fig. 15.4 Frequency of country references in the sustainability press discourse

one hand and neighborhood countries of Europe on the other hand. Switzerland was named 234 times, that equals more than 40% of the total of 564 cited countries, followed by other countries of Europe with 112 references that equal almost 20%. Contrary to the usual dominance of the United States in the international news, its position in the sustainability discourse of the Swiss press is only marginal with 43 citations or a share of 7.6%.

Media Frames

In order to identify and to synthesize relevant media frames, underlying the sustainability press discourse, a total of 85 thematic categories were coded in 401 identified so called issue-paragraphs of the 1,002 coded articles, according to the definition of media frames, proposed by Robert Entman (1993: 52): 27 dimensions in relation to the *definition of the problem*, 35 dimensions in relation to *interpretation of causes*, and 23 dimensions in relation to treatment recommendations. In a second step, these dimensions were reduced by factor analysis that was the starting point of a cluster analysis, resulting in eight media frames that could be identified in about 70% of the articles. These media frames are displayed in Fig. 15.5, where in the last column under the label “affinity” is displayed, if the media frame relates positively or negatively to the sustainability discourse in the sense that recommendations towards a more sustainable development were given or sustainability was valuated positively; contrary the frame could be characterized by ambivalence or even by a judgments or arguments against a more sustainable development. – These eight media frames, that characterize the sustainability discourse in the Swiss press will be illustrated by concrete examples.

Vision Frame: “Prophecies of Future”(14%): This frame is characterized not primarily by a lack of money, but instead by questions of the quality and effectively of the strategies that have to be taken and applied. Proposed laws and actual measures have to be discussed and evaluated in relation to possible realization and concrete effects. The frame is positively evaluated in 60% of the cases. Example: *“The young farmer sees the future problems here: He won’t be able to rationalize more, and more production is also not possible. “If the prices are decreasing further, we will work for five Swiss Franks per hour.” A Swiss agriculture with prices dictated by the world market cannot be imagined by Burren. His vision: “It would be nice, if Swiss products would be recognized on the European market as niche products, because their quality and their ecological and sustainable production are unique.”* (Blick, 10.1.2001)

Economic Consequences Frame: “Money is ruling the world” (6%): Sustainability is defined often as an economical problem, because economic growth is given priority. Market mechanisms are standing in opposition to demands for more sustainability. It is often claimed in relation to causes, that there would not be enough money available for optimal solutions; as a consequence, high costs are identified as the causes for the problem in the sense of no sustainable solutions.

Media Frames	Basic or Sub Frames		Description	Affinity
Vision Frame: Prophecy of Future (14%)	Economy	Effectivity	Future actions and programs will be evaluated on the basis of quality.	positive
Economic Consequences Frame: Money is Ruling (6%)		Efficiency	Only market mechanisms will advance an efficient effort of available money. Everything that costs too much money is disapproved.	positive
Costs Frame: Externalization vs. Truth of Costs (3%)		Effectivity	If costs play a dominant role then costs must include everything. As a consequence, the concept of costs will be expanded to other fields like nature and society.	ambivalent
Application Frame: Actions instead of Words (12%)	Conflict	Competition between Equals	All sides of a conflict are disagreeing in how to solve the problem. There are discussions and dissent instead of actions. The realization fails because of the dissent between the involved parties.	negative
		Public Accountability		
Distribution Frame: Fight between Nations (10%)		Globalization		
		Powerlessness	This conflict is characterized by the dominance to the interests of the North against the South and vice versa the conflict between the poor and the rich countries.	neutral
		David against Goliath		
Freedom Frame: Individualism vs. Collectivism (7%)	Morals, Ethics, Justice	Human Rights	The antagonism between individual freedom and public responsibility is discussed: priority of individual rights versus social duties?	positive towards individual freedom
Need Frame: Solidarity instead of Luxury (8%)		Privacy	Antagonism between humans as social beings acting collectively or rational individuals, maximizing personal benefits and gratifications.	ambivalent
		Economy		
Ecology Frame: Save the Planet! (9%)		Environment	Destruction of nature as universal problem; but mankind has the duty to care for the creation, but be able to use it as well.	ambivalent

Fig. 15.5 Eight media frames, characterizing the sustainability press discourse

Recommendations for actions are therefore formulated on the basis of market principles, even if this means in many cases, that "good" solutions cannot be realized. The frame is connotated positive insofar it is postulated that sustainable development is possible on the basis of a positive growth of economy.

Of course there are negative evaluations as well, as the following example illustrates: "We cannot afford a *sustainable economy* in the presence of millions of people without work in Europe. Arguments for environmental policies are usually rejected in similar ways, and this has functioned mostly until now." (Tages-Anzeiger, 29.4.1999) And under the title "Pointless Limits" the reader finds in an article published by the NZZ on 3/4 February 2007 the following statement: "Cron made it clear that the federal report on air traffic is including the *principle of sustainability* as well besides the goal of growth. Ecological and social reasons could impose limitations to a further demand oriented extension."

Costs Frame: "Externalization versus Truth of Costs" (3%): Because better and ecological solutions are more expensive, they normally have no chances for realization and thus hinder new ways of sustainable development. It is often stated in concrete recommendations for action that there must be "cost truth" e.g. by considering external cost factors too. Put into this perspective, new and sustainable solutions would be in many cases cheaper. The interpretation of the frame is however ambivalent because consideration of external costs can always be criticized as arbitrary or not based on scientific evidence. Example: "It seems to be possible to solve the energy problem or that of the carbon dioxide gas. But the prerequisites will be – besides intelligent ideas and initiatives by the economy and science – political circumstances, that won't hinder the development of these new ideas, but stimulate them. Besides other things, an important contribution would be the *comprehensive calculation of all external costs* and benefits of the various energy- and traffic carriers" (NZZ, 18.7.1995)

Application Frame: "Actions instead of Words" (12%): The main problem is located in not realizing environmental solutions that have possible solutions, and there is consent between most actors about goals and strategies. But because of a lack of control, nobody enforces the necessary strategies for implementation and realization. More efficient international regulations are demanded. But this needs time, and the available time is limited. The valuation of the frame is negative, because another delay of the necessary actions might have the consequence of irreversible damage; there is a wide disappointment concerning taken so far actions towards more sustainable development. Example: "There is a more or less consensus, that significant economic growth is needed. And almost everybody is saying that this needs to be *sustainable*. But, what sustainable means and what actions will lead toward the goal – opinions diverge strongly" (Blick, 7.11.2003). "In Johannesburg, Switzerland is enforcing measurable goals, explicit obligations and clear terms for implementation and useful mechanisms for control. The technical and material resources are available, federal chancellor Deiss emphasized in his speech. But what is missing would be a common determination to act definitely. The obligations of the state in the domain of a *sustainable development* should therefore be complemented by partnership projects with the civil society, the economy and science" (NZZ, 3.9.2002).

Distribution Frame "Fight between Nations" (10%): It is declared as problematic, that the resources of the world are distributed not in a fair way between nations; and this is leading towards social tensions on the one hand and towards plundering of nature on the other hand. As a main source, the historical, cultural and economical differences between north and south are stated. Recommendations for action go in the direction that existing finite resources should be distributed more equally. The evaluation is varying, because, e.g., the blame for the misery of the south is attributed to the countries of the north; on the other hand the developing countries are held responsible for not enough action on their own initiative. Example: "The Third World countries will hardly be ready it is said to take responsibilities, as long as the worldwide greatest polluter of the air, the United States, in their own country will not take sustainable efforts in the domain of climate protection." (Tages-Anzeiger, 26.10.2001)

Freedom Frame: "Individualism vs. Collectivism" (7%): This antagonism is defined by the question of responsibility which has to be taken by each individual just as much the state. The question is, if volunteer actions are adequate or whether obligatory rules and sanctions are necessary. In relation to causes, it is assumed mostly that volunteer actions will only operate well if everybody is engaging; but missing controls always will be a problem. As a consequence, individual freedom and self-responsibility are important, at the same time it is emphasized that individual freedom has to be limited in favor of the collective welfare. The affinity of the frame is ambivalent, depending on whether individual freedom is favored over collective interest or if collective welfare is given priority. Example: "The principle of individual freedom sounds good, but does not force anybody to act according to specific norms. But indeed, isn't the state necessary to formulate specific norms and rules? This is one of the fundamental weaknesses on the international level." (Tages-Anzeiger, 26.8.2002)

Need Frame: "Solidarity instead of Luxury?" (8%): Sustainability is seen as a problem, because in general, individuals want to satisfy personal needs at all costs. Consequently, solidarity with others is turned down. Thus, an important recommendation for action will be that environmental resources are preserved and distributed in an equal way as much as possible. But this requires that people have to be educated towards more solidarity. The affinity of the frame is ambivalent insofar it points towards the ability of man for solidarity and altruism on the one hand; on the other hand, there is the pessimistic view of people as basically egotistical. Example: "Everything depends on the origin of these needs, which do not exist in an absolute way. *Sustainability* requires – understood as normative ethical concept – global and inter-temporal solidarity and justice: Each person has the right to satisfy their needs, but without impairing the possibilities of others, today or in future. To question the legitimacy of our luxury (sic) needs should not be sacrosanct" (NZZ, 14.4.1999).

Ecology Frame: "Save the planet!" (9%): The contamination and destruction of nature are the biggest problems within the sustainability discourse. Nature and the living species are a limited resource that can't be exploited in an unlimited way. Therefore, there is the danger, that nature will be damaged by overexploitation in an irreversible way. The enforcement of conduct based on knowledge and behaviors that assist sustainability is recommended. The affinity of the frame is ambivalent since the chances for success of potential strategies are insecure, although the problems have been recognized. Consequently, the future is perceived in a rather pessimistic way. Examples: "With reference to the claims of the 'Earth Summit of Rio' 1992, Felix Näscher, director of the federal forestry office, demanded in an introductory lecture a clear *commitment for sustainable development*. In his words, the preservation of the biological diversity has to be assigned highest priority" (NZZ, 13.4.1995). Or, the German news magazine "Der Spiegel" (2007) reported under the title "Environmental Protection. Saving the Climate": "The environmental organization Greenpeace and the European Ceiling *Organisation of Sustainable Energy* (Erec) are presenting a global master plan to prevent the threatening climate change. The global climate could be saved, if politics and economy would act immediately, these are the positive conclusions of the feasibility study."

Summary of Media Analysis

The environment in general and sustainability in particular got more attention recently in the public sphere and in communication science, although a deficit in theory and research is still the case. Besides the questions of the resonance of the sustainability issue in the media and the quality of environmental media coverage, empirical communication research is analyzing increasingly the *effects of environmental media coverage on* the personal agenda, knowledge acquisition and on behavior towards the environment.

Empirical evidence was presented in this contribution, based on a longitudinal quantitative content analysis of the sustainability discourse in three Swiss newspapers (Neue Zürcher Zeitung NZZ, Tages-Anzeiger TA, Blick) between 1993 and 2003:

- *Amount and form of coverage*: Four references to "sustainability" in a broad sense have been found in each issue of the quality paper NZZ and at least one reference per issue in the forum paper TA; whereas the concept is almost absent in the popular paper Blick, namely because of an absence of prominent people. But only between 20% and 40% of the semantic word usage concerns the meaning of sustainability in a more precise way. The limited possibilities to personalize and emotionalize, but the absence of scandals associated with the concept of sustainability could possibly explain the limited resonance of the sustainability concept in the media, besides the fact that the sustainability concept has to be characterized by its abstractness and complexity.
- *Trends*: The sustainability debate has increased significantly during the 1990s in the Swiss press, especially triggered by the Rio Conference in 1992.
- *Dimensions of the debate*: A more detailed analysis of media topics revealed that different components of the sustainability concept dominate the media discourse: References to society (29%), to economy (26%) and to ecology (19%) are prominent; in comparison spatial (15%) and temporal (11%) dimensions are less

pronounced. The societal focus increased over time; but ecological and temporal aspects decreased.

- *Trends*: These global trends in media coverage are manifest in the course of single themes: strong increase in finance (trade, world economy) and agriculture (ecological production, subsidies); but a decrease of topics like natural resources, energy, labour. The general trends have been moderated by the type of newspaper: Whereas economical topics, followed by political questions are prominent in the elite press, political issues are discussed with priority in the forum press; in contrast, sustainability is reported mostly in the context of so called human interest stories in the popular press.
- *Topics*: The content of the three newspapers is thematically different: economy is most important followed by politics and culture in the elite paper; politics is leading in the forum paper, followed by economics and culture. Whereas human interest is prominent and politics is missing in the boulevard press.
- *Causes*: Published scientific reports on the one hand and prominent meetings or conferences of politicians and experts trigger especially press coverage; journalists on the other hand lean most heavily on official sources (Sandman 2008). As a result, media coverage is mostly reactive, based on public relation activities of those groups being interested in the sustainability debate. Thus, prominent actors from politics and economy dominate the media discourse; surprisingly experts from science play only a minor role.
- *News Geography*: The sustainability media discourse is located especially in Swiss and European settings; Switzerland is the most stated nation with 41%; not surprisingly, U.S. is almost absent in the discourse.
- *Eight frames* have been identified on the basis of a cluster analysis which structure the sustainability discourse in the Swiss press: (1) The vision frame "Future Developments", (14%) together with (2) the application frame "Actions instead of Words" (12%) are leading the sustainability discourse, followed by (3) questions of distribution in the form of "Struggle of Nations" (10%), (4) ecology frame "Save the Planet" (9%), (5) the need frame "Solidarity instead of Luxury" (8%), and the freedom frame "Individualism vs. Collectivism" (7%). In comparison, the economic consequences frame "Money is Ruling" (6%), together with the costs frame "Externalization vs. Truth of Costs" (3%) are playing only a minor role.

Up to now, no media frame has been established as the dominant interpretative pattern of the sustainability discourse, and there have not been any major changes over time. Considering the thematic heterogeneity of the media frames, together with the politically and culturally very diverse structure of the sustainability debate, this seems to be comprehensible. In addition, the concept of sustainability cannot be easily popularized by the media, especially because of its complexity and lack of concreteness. But this could change rabidly, e.g., as a consequence of the intensifying debate of the climate change, than the ecology frame "Save the Planet" could be more significant.

Conclusions

Environmental communication slowly became a topic in communication research in Germany and Switzerland since the mid-1980s, but its topic and theoretical perspectives remained multidisciplinary and fragmented in contrast to the better defined research areas of science and risk communication. In addition, even less attention has been given to *sustainability* as an even more complex multidimensional and interdisciplinary concept. This is partly due to the fact, that sustainability lacks a clear definition and is without a visible focus that would attract media attention. As a consequence, there is a need for more conceptual discussion as well as empirical communication research. After all, the sudden and intense media attention given to the issue of climate change and boosting its media attention cycle gives hope that there will be more communication research in this area. An even more future oriented challenge will be in developing effective communication strategies for a more sustainable development of society, being able to overcome the existing cognitive, affective and social barriers (Takács-Sánta 2007). But a high level of environmental concern is certainly an important prerequisite for long-lasting sustainable development.

One important factor is certainly the amount and quality of information on environmental problems being communicated by modern mass media. This contribution tried to demonstrate, based on a *theoretical review of the communication literature* together with a *content analysis of media coverage of sustainability*, that environmental problems in general and sustainable development in particular, are still not prominent media topics and are often based on antagonistic media frames, fragmented discourses and with a negative bias. In addition, media and media owners are dependent on advertising and thus tend to reinforce the status quo of the existing mindless consumer society. As a result, even when environmental problems or sustainability as issues are treated by the media and journalists, there is rarely a deeper and more systematic discussion of possible and specific strategies and solutions. So, even when people are aware of and do understand the particular causes and consequences of an environmental problem like 'global warming', they often are not able to see anything that they can do to reduce or solve the problem (Stamm et al. 2000). But an active and critical environmental journalism and media with quality oriented content still remain important sources of information and orientation for most people and are therefore necessary prerequisites for more sensitive attitudes and more engaged behaviors towards nature, environment and a sustainable development.

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Chapter 16
The Experimental Turn in Environmental Sociology: Pragmatism and New Forms of Governance

Christine Overdevest, Alena Bleicher, and Matthias Gross

Abstract Drawing from American pragmatist thinking this chapter knits together European and North American approaches on decision making under conditions of ignorance and uncertainty. By doing so, the chapter develops an experimentalist policy logic based on the writings of early pragmatists as well as the Chicago School of sociology to exemplify an example of experimental governance and strategies for continuously coping with ignorance in the remediation of areas with multiple contaminant sources and plumes related to industrial activities in the former socialist east of Germany. Finally, the chapter fathoms further possibilities and limits of an experimental approach in environmental sociology.

Keywords Experimentalism • Ecological design • Chicago School of Sociology • Pragmatism • Contaminated sites

Introduction: Experimentalist Governance

In recent decades debates on how to "robustly" integrate views on social acceptability and scientific reliability via experimental approaches has gained in importance in environmental sociology and related fields. This chapter will illustrate the potential of this experimental turn for environmental sociology and its pragmatist implications. In departing, we note that although American pragmatism has influenced environmental sociology through the writings of Jürgen Habermas

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and his influence on the “participatory paradigm” – i.e., the idea that public participation is necessary to create legitimate decisions (Parkins and Mitchell 2005; Bulkeley and Mol 2004) – the generally negative attitude toward ecological reform in North American environmental sociology has somewhat obliterated the many positive aspects of a sociological pragmatism and its potential for environmental issues. Instead, American environmental sociology is captured by alarming stories about the world inexorably in environmental decline – sometimes marketed under the label of “sociological criticism” – engulfed by rising oceans as the inevitable outcome of climate change, the human demand on the Earth’s ecosystems and natural resources, as well as the claim that capitalism is the source of all evils. In contrast, after a similar phase of doom-and-gloom literature in the 1970s and 1980s, today hardly any European environmental sociologist is interested only in, e.g., Marxist musings on ecological degradation or the purely negative stance on anything “modern” anymore. The general goal is to search for possibilities of human adaptation to natural changes, to fathom the resiliency potential of human societies, and strategies to successfully link ecological issues with social development. Along side of the well-known ecological modernization paradigm, in recent years a framework has resurfaced in Europe and elsewhere, which tries to develop a more experimental strategy at solving environmental problems. This framework, although heavily influenced by North American pragmatism, leaves pessimistic North American environmental sociology behind. After all, assessing the positive potentials of human societies’ relations with the natural world also means a tolerant attitude towards social experimentation and new forms of participation.

In further drawing from American pragmatist thinking, we call for moving beyond the participatory or “communicative” governance approach of Habermas to a more experimentalist approach which knits together European and North American thinking on decision making under conditions of ignorance and uncertainty. We develop the notion of experiment based on the writings of early pragmatists as well as the Chicago School of sociology. The basic driving image behind experimentalist governance is that every environmental (policy) intervention is like or could be like an experiment. It provides a way to compare hypothesized to observed outcomes. Experiments generate learning through surprise and in so doing can help empower citizens, activists, and other publics to challenge outdated or narrowly held and self-serving ideological views. Yet we often fail to be aware of the democratizing potential of such experiments, e.g., their ability to generate learning through surprise. In this paper, we argue that policy experiments should be conscientiously treated as public trials which will increase the political dialog and public debate about local environmental problems. By conscientiously intending to publicly set up and learn from experiments, we can weaken the dominance of elites compared to approaches emphasizing primarily communication and deliberation. An experimentalist governance approach can achieve the American pragmatist vision of “mobilizing the public, revitalizing public discourse, and getting (citizens) personally involved in politics” (Shalin 1992: 245). The remaining challenge of an experimentalist approach is how to develop policy commitments among administrative elites to move toward an experimentalist rather than merely participatory approaches.

In the following pages, we consider a program of experimentalist governance. First, we review the American pragmatist roots of both the communicative and experimentalist approach to pragmatism. Then we develop an experimentalist policy logic and consider the benefits, to be supplemented by an example of experimental governance and strategies for continuously coping with ignorance in the remediation of areas with multiple contaminant sources and plumes related to industrial activities in the former socialist east of Germany. In the final section we consider the outlook for an experimental approach in environmental sociology.

The Pragmatist Roots of the Participation Paradigm and Experimentalist Governance

Both experimentalist and communicative governance is pragmatist in its underlying theoretical roots. American pragmatists point to the social bases of language and reason. The development and use of language is not the individual accomplishment of a solitudinal thinker (Mead 1934; Shalin 1992). Rather meaningful communication is the practical accomplishment of intersubjective understanding among a community of inquirers that requires being able to take or understand the perspective of the other (Peirce 1877). As Mead (1934: 253, 256) wrote, “The very organization of the self-conscious community is dependent upon individuals taking the attitude of the other individuals.” … “The principle ... basic to human social organization is that of communication involving participation in the other. This requires the appearance of the other in the self, the identification of the other with the self, the reaching of self-consciousness through the other.” The belief that meaning and reason were social in nature – i.e., required mutual cooperation and collaboration in its construction – led early pragmatists to believe that an important part of the route to progressive social change lie in democratic deliberative approaches to addressing pressing social problems. These ideas are best illustrated by Dewey’s lifelong commitment to extensive citizen participation in politics as opposed to technocratic decision-making and his emphasis on public education as a means of achieving a more democratic society (Dewey 1927).

These pragmatist insights on knowledge, language, and community, inspired Habermas (1987) to develop his ideas of communicative rationality and the public sphere. From pragmatist insights, Habermas saw the possibility that a discourse ethics and a vibrant public sphere could break the stranglehold on rationality by elites, a major concern of the critical theorists with which he was conversant. He argued that embedded in the logical relations of the pragmatist conception of meaning was an emancipatory potential in modernity (Habermas 1987). Namely, that if it is the case that partners in communication agree that communication is legitimate, then setting up participatory discursive opportunities where speakers can be challenged to present the reasons underlying a claim and be confronted with competing reasons could liberate more work legitimate (i.e., deeply socially justified) decisions.

Discourse ethics created the best, in Habermas's view, potential institutional design to free communication of distortion by strategic elites. Decisions made through communicative processes offered, he argued, a more legitimate basis for democratic politics, policymaking and planning.

As already noted, these pragmatist ideas developed by Habermas have trickled down to environmental planning discourse since the 1970s and research in environmental sociology has examined a wide range of participatory decision processes (Parkins and Mitchell 2005, Bulkeley and Mol 2004). However, we argue that, in the ideal type case, it is not enough to bring local actors into deliberation where their varying presumptions and biases will succumb to the force of the better argument. The actual power to have a say in political decision making is easily taken away from the participants (see Pellizzoni, Chapter 10 in this volume; Yearley et al. 2003). Furthermore, the Habermasian ideal type case could not be further from real-world decision making which is characterized by many unknowns and uncertainties that cannot even be fathomed via risk assessments and computer modeling, let alone mere citizen participation. Rather we draw on additional insights developed by pragmatists who call for a more experimental approach to governance in the light of uncertainty and capture by political elites.

Approaching Environmental Interventions As Experiments

Governance is often used in reference to government to allude to the catchphrase "From Government to Governance" (Stoker 1998). In general, the transformation process from top-down governing to more bottom-up governance aims at stronger involvement of stakeholders and shared responsibility (Hajer and Wagenaar 2003; Peters 1998). On many levels, new governance elements have been established showing a great variety of possible hybrid or mixed decision approaches. When it comes to decision making, in many areas of contemporary environmental governance, the role of science and its "sound principles" are still seen as a privileged form of knowledge production that renders inferior other forms of knowledge (cf. Giardina et al. 2007; Walters 1997). The ecologist Andrew Bradshaw explicitly bolsters the authority of science in, for instance, ecological management processes by reminding his readers that "ecology as originally defined by Haeckel is a science" (Bradshaw 1993: 147). However, it is clear to most practitioners that scientific knowledge, as well as research, in general is always limited by human ignorance, which makes reliance on science in new forms of governance important, but nevertheless tricky, since the actors involved, in order to be able to act, need to agree on what is *not known* and take it into account for future planning. On a community level, risk assessments as well as applications of different versions of the precautionary principle have been applied to establish ex-ante devices for guiding and dealing with complexity and uncertainty in ecological projects. Important as these principles have been in triggering discourse and redistributing responsibility, quite often their institutional agency has been limited. One reason for this is the unsolvable dilemma of not knowing 'before the trial' whether or not the social and ecological risks are acceptable and whether the knowledge for an intervention has been sufficient.

In the following we will add to the debate on environmental governance and the challenge of coping with ignorance an experimental view. Whereas the faith in total control and full knowledge of ecological systems and social processes implies an ability to act only when everything is known in advance, an experimental approach allows us to accommodate different factors in spite of gaps of knowledge. Experimental governance is thus to be understood as a means to launch an environmental project in spite of uncertainties and uphold the project without disrupting the overall process. In this framework, experimentation is a mechanism whose aim is not to overcome or control environmental uncertainty, but to live and blossom upon it.

The idea of communicative governance is that by bringing actors into deliberation better plans of action can be created. The governance implications are largely procedural. Governance should be about constructing ideal speech situations in which actors can create intersubjective understandings around ecological projects and exert their capacity for communicative action (Habermas 1987; Joas 1997). However, there are central elements of pragmatism that Habermas failed to develop and which push the debate about the institutional requirements of good governance in modern society much further.

These perspectives argue that it is not enough to bring actors into reflexive debate where their presumptions and biases can succumb to the force of the better argument. Rather a number of additional procedural mechanisms or institutional rules of governance are needed. In particular, the neo-pragmatists lean much further toward the need to supplement ideal speech situations with *active public experimentation* (Cohen and Sabel 1997; Dorf and Sabel 1998; Unger 1998; Gross 2010; Levidow and Carr 2007; and Krohn and Weyer 1994).

The point of experimentation is wholly pragmatic – to create and facilitate the building of a community of inquirers who locally deliberate social problems, form hypotheses about appropriate means and ends of practice, and put their assumptions to test. This particular prescription draws not on pragmatism's symbolic interactionist legacy (which Habermas drew from) but from its distinctive *theory of action*. The pragmatic theory of action puts forward the additional claim – beyond the discourse ethics of Habermas – that the meaning or truth-value of an idea is tied to its practical consequences. As Dewey (1958 [1925]: 173) wrote "Language is a natural function of human association; and its consequences react upon other events, physical and human, giving them meaning or significance." Furthermore, actions which prove to be particularly useful often become reified, according to pragmatism, as unreflective truth. In Pierce's original formulation they become hardened or "congealed" as habit. As Dewey (1958 [1925]: 184) noted: "meanings that (are) discovered to be ….indispensable (are) treated as final and ultimate in nature itself." But pragmatists did not believe that such congealed habits were final or nature itself, rather much of nature and social life was contingent, diverse, and dynamic – or just unknown – so that habitual social scripts (including potentially competing, strategic ones) always needed to be checked for their utility. For this reason, experimentation is seen as just as important a method or discipline as broad participation for a communicative pragmatist. Experimentation offers discipline and provides accountability to our social scripts.

It is in this sense that pragmatists find the notion of experimentation so important. The argument is not the naïve one that one true truth will be found via such experiments, rather that the process should generate conditions for greater learning through surprise. If the meaningful world of objects and relations is not just a product of human interpretation of the world but of active interaction with it, and what we often accept to be true is "hardened" or "congealed" habit while nature is always more complex than our habits, experiments serve a profound purpose – to discipline our beliefs. In the following sections, we consider how an experimentalist approach might be organized.

Further Toward an Experimentalist Approach

Whether the social sciences in general and sociology in particular could ever be experimental sciences that model themselves on the natural sciences has been controversially debated since the beginning of the institutionalization of the social sciences in the late nineteenth century up until the current day. One has to keep in mind: It was not before the early 1900s that a clear definition of experiment as a comparative measurement of experimental and control groups emerged and it was not until the 1950s that randomly controlled trials became a sort of ideal type experiment in the social sciences (e.g., the work done by Donald Campbell and his co-workers since the 1960s). Even if these experiments do not always include random assignments to various treatments, they are nevertheless based upon deliberate interventions which serve to describe and understand causal effects. Large-scale social experimentation hit its first peak in the 1970s and it never ceased to play a part in public reform projects. However, from a methodological point of view these "quasi-experiments" always have been considered as more or less deficient models of laboratory experiments. Thus for Campbell the dominant question was how to compensate for the "threats to experimental validity" (Campbell 1969: 409).

In contrast, early American sociology, especially the so called Chicago School of Sociology beginning in the 1890s, has used the notion of experiment in a different manner. To Albion W. Small, the first professor of sociology at the newly founded Department of Sociology at the University of Chicago, every outcome of a social process is based on an experiment. Small stated:

> All life is experimentation. Every spontaneous or voluntary association is an experiment. Every conscious or unconscious acquiescence in a habit is an experiment. […] Each civilization in the world today, each mode of living side by side within or in between the several civilizations is an experiment" (Small 1921: 187).

He goes on to point out what that might mean for sociological research:

> All the laboratories in the world could not carry on enough experiments to measure a thimbleful compared with the world of experimentation open to the observation of social science. The radical difference is that the laboratory scientists can arrange their own experiments while we social scientists for the most part have our experiments arranged for us (ibid.: 188).

Viewed from the perspective of mainstream science with its emphasis on statistical or laboratory controls, the fact that "social scientists have our experiments arranged for us" leaves many observers skeptical of depending on real-world experiments. However, mainstream observers forget the significance of the social scientific enterprise is not lab findings per se but it is the usefulness of the applications in the real world. Once the results of controlled experiments are reintroduced into their complex natural environments, their chance for failure increases the degree to which the experiment isolated contextually important effects, i.e., the problems of social and environmental complexity return. This calls for a new approach to social science that honors contextual complexity and seeks to identify useful generalizations of process in complex environments (Abbott 1997, 1998).[1]

An example from recent policy will serve to illustrate. One response to the current energy crisis is for governments to encourage investments in alternative fuels. Ethanol produced by combining corn or other bio-based fuels with gasoline is one option championed by some, purportedly because it can decrease dependence on dwindling global oil supplies and decrease greenhouse gas emissions. The Bush Administration signed into effect legislation that encourages ethanol production by offering a 51 cent a gallon tax credit (and puts a 59 cent tariff on imports of ethanol – suggesting the legislation is as much about protecting US farm interests as addressing carbon emissions). However, since it has gone into effect, world food prices have shot up creating a new potentially serious problem of food insecurity and concerns have been raised that higher prices for agricultural goods will increase forest clearing which will increase carbon release (World Bank 2008). The World Bank has recently argued that most of the increase in U.S. corn prices is accounted for by the recent economic incentives. The solution to one policy problem, because it involved a narrow view of the problem (or because it was motivated to support narrow interests), potentially produced unintended effects which beg for discussion.

An experimentalist governance approach would welcome putting assumptions like "incentivizing ethanol production is good" to provisional test because observing the effects can lead to debate about the assumptions (and biases) implicit in the policy. Pragmatist methods seek to learn from experience so that complexity and surprise is respected. What specific institutional and organizational designs or routines

[1] The environmental social sciences, because of the influence of ecological thinking, which embraces complexity, has produced more recursive approaches (e.g., adaptive management and complexity theory).

might create an experimentalist community and how do we see these creating circumstances for tests of assumptions and respect for surprise beyond the communicative approach?

Local Problem Solving and Learning from Experiments

Experimentalism seeks to encourage local jurisdictions or communities to experiment with ways of achieving standards for environmental quality (air quality, water quality, adequate participation), while it calls for the broader pooling and sharing of information across experiments to help improve public understanding and accountability. Putting local problem solving to test as though these efforts were provisional practical trials allows a variety of actors to intentionally evaluate and deliberate on the effects of experiments and in so doing can help empower citizens, activists, and other publics to challenge outdated or narrowly held and self-serving ideological views.

Such policy experimentation may further the discovery of effective practices within local contexts or lead to surprising failures. Like experiments in the laboratory, experimental approaches outside the clearly defined borders of science often bring surprises. Georg Simmel, in an essay entitled "The Notion and Tragedy of Culture" (orig. 1911, revised and extended 1923), called things that are originally created and designed by humans and for humans, "in their intermediate form of objectivity, which they take on in addition to the two extreme instances, they follow an immanent logic of development, that estranges them both from their origin as well as from their purpose" (1998: 213). He subsequently observed that "as soon as the human-made work is completed, it not only has an objective being and an individual existence independent of humans, but also holds in its being . . . strengths and weaknesses, components and significances, that we are completely innocent of and which often take us by surprise" (ibid.). The ecologist C. S. Holling defines surprise similar to the way Simmel uses it in the context of his relation between subjective and objective culture:

> Surprise concerns both the natural system and the people who seek to understand causes, to expect behaviors, and to achieve some defined purpose by action. Surprises occur when causes turn out to be sharply different than was conceived, when behaviors are profoundly unexpected, and when action produces a result opposite to that intended – in short, when perceived reality departs qualitatively from expectation (Holling 1986: 294; original emphasis).

As such, a pre-existing set of experiences and a horizon of expectation turn out to be inappropriate, since the real situation contradicts any anticipation. A surprise thus is able to come out of the blue and is able to transcend the normal scheduling and routine mobilization of events. If the interaction between human activities and the natural world is recognized to be inherently uncertain, surprises – including the fostering of these surprising elements – can become opportunities to learn rather than failures. As successful projects such as in environmental decision making and ecological restoration thus need a public that is ready to acknowledge uncertainty in all ecological practice, since the unexpected is part of living in nature. Thus people not only need to be ready to participate themselves, but also to take responsibility for the sometimes surprising side-effects of their actions. Otherwise, experimental learning will not work. Thus negotiations need to take place between different stakeholders who participate as fully valued actors and knowledge producers with respect to the management of surprising events, whether these stem from the social or the natural system.

Similarly, pragmatists would argue that surprise comes not just from the complexity of the situated environment but from the human cognitive dependence on simple theoretical frames and heuristics in dealing with that complexity. Because the world is so complex we deal with it by constructing stories or frames that provisionally make sense of complex situations. Like any theory, these stories select and interpret some elements in the environment and ignore others. Surprise comes when our frames fail to explain. For this reason, Peirce (1998 [1903]: 235) argues that a "good" hypothesis or explanation, on the other hand, is one that leads to the absence of surprise:

> The question of the goodness of anything is whether that thing fulfills its end. What, then, is the end of an explanatory hypothesis? Its end is, through subjection to the test of experiment, to lead to the avoidance of all surprise and to the establishment of a habit of positive expectation that shall not be disappointed.

Pragmatist governance addresses these general concerns by designing governance systems to learn from surprise. Concretely one must involve participants in dialog over the aims and results of experiments in light of expectations. Opening discourse and analysis to debate over competing frames broadens the opportunities to test simple assumptions – such as incentivizing ethanol is good – and encourage informed debate beyond the communicative approach. Pooling information across different policy experiments and making it publicly available allows civil society to compare and politicize, i.e., render more open to broad public debate, policy effectiveness. Which local experiments achieved the most pollution reduction or improved water quality? How? These kinds of questions can be asked when policy interventions are treated as experiments. These evaluations lead to learning from across experiments. In this sense, experimentalist governance seeks to generate a richer empirical base of input into the public sphere than a communicative approach would facilitate.

Increasing Political Accountability

Furthermore pooling and publicizing results across experiments empowers actors to demand public accountability. NGOs, civil society groups, and think tanks can use the data generated by experiments to bring political pressure on regions and localities that cling to ideological or self-serving policies. By publicly highlighting and distinguishing what works well and for whom, civil society can bring pressure to bear on states or communities.

Political scientists have referred to this mechanism as accountability politics (Keck and Sikkink 1998). Keck and Sikkink argue that when civil society can show that states or other actors behave contrary to their public claims (to sustainability or high standards of social performance) advocacy campaigns can create effective pressure by being able to clearly point out the discrepancy between public principle and performance. An experimentalist governance regime by increasing the public statements of goals and providing transparent results increases the likelihood that civil society may demand better adherence to public goals. These accounts provide a description by which a regime of experimentalist governance may improve accountability compared to communicative participatory processes. It is the capacity to draw from the richer practical information that sets the experimental governance regime apart.

Finally, because experimentalists believe that policy experiments themselves change the social realities to which they are directed (and i.e., produce unintended consequences of their own), policy learning itself must be iterative and ongoing. Some authors have referred to this process as "recursive learning" or "recursive practice," (cf. Crozier 2007; Constant 2000; Krohn 2007; Gross 2010), which refers to a process of governance where the overall integrity of an environmental decision and management process can be upheld based on its recursive aspects, that is its ability to accommodate revisions and modifications to issues that changed, although they were previously agreed on. With broad participation and revision, the hope is that a more experimentalist regime will help overcome narrow specialization by increasing the breadth or scope of information and interests in decision making. An experimentalist regime poses the need for on-going revision and reflection, over the long term, to prevent the ossification of habit or the entrenchment of narrow self-interest. Now, let us turn to the example from a major remediation program for regionally contaminated aquifers in eastern Germany to illustrate processes of restoring these sites with a special focus on the acknowledgment of ignorance, openness to surprising events and revision of practice by the actors involved. Like the experimenters in a laboratory, the heterogeneous actors involved in the remediation of contaminated land understand surprising events in the process of remediation as the norm and not as failures.

Remediation of an Industrial Site: Experimental Strategies for Dealing with the Unknown

The presented example is part of a larger project on the *Research on Sustainable Revitalization of Waste and Complex Contaminated Areas.* In this program, scientists develop technical solutions and management concepts for the revitalization of contaminated sites. Based on a step-by-step approach, innovative technologies and large-scale technical devices are applied to investigate extensive and complex contaminated areas. Management strategies are expected to be developed on the basis of the analysis of remediation processes. One case study for this analysis is the town of Weissandt-Gölzau, situated in the federal state of Saxony-Anhalt in the formerly socialist part of Germany.[2] This town harbors a very prosperous industrial area with lots of soil and groundwater contamination originating from a long industrial history. In a way, the prosperity of this town is an exception in eastern Germany, since most rural and semi-urban regions in the former socialist east today suffer from de-industrialization, high unemployment rates and population decline.

Industrialization in Weissandt-Gölzau began with coal mining. In the 1920s brown coal refining was added to its core industries, including a carbonization plant to distillate fuel and tar. Much of the contamination originated from these early chemical industries in the 1920s, when records of accidents and waste disposal documenting the extent and location of contamination were rare. During the end of World War II contamination happened when fuel tanks were emptied during allied bombings. These events, of course, were not systematically if at all recorded. During the 1950s and 1960s the processing of raw material changed from coal to oil. Polyethylene film production started and was accompanied by a mechanical engineering enterprise. After 1990, with the overall socio-economical changes in the region, the enterprises in Weissandt-Gölzau have been completely restructured. Today, the town hosts two large companies of international importance. First of all there is the Pergande-Company, which produces industrial filter systems, granulation equipment and the fabrication of diverse granulates as additives for, e.g., fertilizers and cleaning agents. The second major company there is ORBITA-Film, a leading German manufacturer of polyethylene films and construction films, employed in the packaging and construction industries as well as in agriculture and market gardening.

In the course of economic restructurings after World War II, during the 1950s and 1960s and especially after 1989, many parts of the industrial facilities where rebuilt, buildings were demolished, sinks filled, and other buildings constructed at the same place. Today only very little documentation (archive materials or maps) about these changes exists, most of the little information that might have been available disappeared when responsibilities changed after 1990. Understanding of contaminants improved somewhat in the 1990s when new enterprises moved into the industrial area. In view of their intention to undertake development, they had a strong interest to evaluate if the territory contained contamination and which environmental risks and dangers had to be expected. Consequently, during the years between 1990 and 1996, specialized engineering companies were contracted to

[2] Data for research on the remediation process come from different sources, ranging from meetings and the observation of activities at the site, minutes of previous meetings, and published material. Semi-structured interviews with 17 stakeholders of the process carried out between February 2006 and November 2007. The analysis of the material was stimulated by grounded theory in the tradition of Glaser and Strauss (1980).

investigate water and soil contamination. Potential risks were identified for several brown-field areas but no remediation measures were carried out.

In 2001 after council elections, a deputy of the new municipal council supported the idea of improving the infrastructure (i.e., building roads and the restructuring of the sewage and fire water system) in order to offer good conditions for economic development and to attract further investments from new companies. Together with the city's mayor the political representatives in the municipal council were persuaded of the need for action in the industrial area. During the following 3 years diverse actors such as local enterprises, planning and consulting companies, local and regional administration agencies, public funding agencies, and remediation experts participated in a visioning process. The actors negotiated their different positions, ideas and goals concerning the industrial area of Weissandt-Gölzau. Finally the actors agreed to the common goal of improving the public infrastructure in support of local and regional economic development. This overall goal and the time frame were finalized in a contract at the end of 2005.

Due to the knowledge about the industrial history, the community, as well as the responsible regional and district authorities and all other involved actors, were aware that construction activities in the area would have to deal with contaminations of unknown dimensions, or what can be called unspecified ignorance. One could say that the actors involved in the infrastructure project were aware of their own *ignorance* (contaminations in unknown dimensions) – they expected the unexpected. Given the unknown dimensions of contamination, a limited project budget and a strict project time frame determined by public funds, the involved actors knew that they would have to make decisions based on non-knowledge, since no risk assessments were possible because the important parameters were unknown. As such they took an explicitly experimental approach to remediation. This entailed collectively agreeing that surprising findings in the remediation processes would be addressed as they arose, and if significant would trigger additional debate and a new consideration of public views toward the project plan. They understood planning and remediation processes to be learning processes, triggered by the discovery of surprising contaminants. The head of the state authority for the exemption from pollution liability even told the general public in his opening speech, during the festivities that would highlight the first major step in building new roads through the industrial site that they have been so successful because they knew how to deal with surprises. In other words, the benefits of this approach were that the community could proceed with public infrastructure development while to wait for more complete scientific knowledge would have created a false sense of certainty, and extended the project time frame, while limiting the public input.

Varied actors were involved in the concrete realization of the project and contracted, such as planning-, engineering- and construction companies, as well as experts in contamination and remediation. A strategy for realization and a detailed plan were worked out by a planning company before construction work started. When the construction of the first of four new streets began the workers were confronted from the first day with surprising findings such as: hard-to-date metal containers filled with tar, soil contaminated by tar, old basement foundations and old cables. Each time, in accordance with the plan negotiated by stakeholders, quick solutions for disposal were found by construction managers, and construction work continued. Less profound adaptations to the construction plan, such as the location of the access road to the company premises were realized easily. Some surprises, such as the discovery of a 30 t container with different heavily acidified liquids, sometimes questioned "the whole philosophy of the project," as the representative of the management firm overseeing the infrastructure and remediation project pointed out. However, such events were followed by intense discussions of all stakeholders and profound adaptations (e.g., new planning, change of permissions). The most important of these events was described by a responsible person from the local administration in an interview: "Construction and cleaning-up has to be understood as a continuous process. They [the workers on the ground] started to remove the material and by doing so they found that the subsoil was totally different from what we expected. The problem is that tar, which becomes liquid with the corresponding temperature, makes it necessary to use another type of water barrier for the rain storage reservoir." Such revision of plans and necessarily new strategies were discussed and decided by involved actors: companies, administration authority, financier and political representatives of the community. Weekly consultations at the site fostered the opportunity for these discussions. Although plans and strategies were changed, the overall goal – to improve the infrastructure – was pursued all the time. The realization of the project could be observed by the population easily for two reasons: *firstly* the site was accessible all the time so people could see what happened. *Secondly* the coordinating company installed a temporary office at the site so that all persons who were interested in the ongoing project, e.g. inhabitants of Weissandt-Gölzau, representatives of local enterprises etc., could get information easily. The project (infrastructure constructions and with it connected remediation measures) was rendered to be successfully finalized in November 2007, explicitly, as pointed out above, because the actors involved acted in face of ignorance and expected surprising events which indeed sometimes led to a revision of the original plans.

As the analysis of the example reveals, the overall strategy to deal with unexpected events was based on accepting what was unknown and thus to build absorbing and flexible measures around the unknown. The acknowledgment of ever increasing ignorance did not seek to prevent an occurrence of a surprising finding of contaminants, but it accepted that the event will happen anyways, but will deliver flexible adjustments such as in the change of permissions, flexibility in the change of plans and a certain flexibility to redeploy capital for remediation measures. To succeed with this strategy all stakeholders had to be prepared to be flexible in their responsibility. A main factor which helped to create such an "experimental attitude" could be detected in our interviews: It was the participation of all stakeholders and their explicit agreement on shared objectives at an early stage of the project.[3] This explicit agreement was expressed in the contracts made between the actors.

[3] Says one major representative: "Early on you have to get the right people to the table, people that trust each other and also have some credibility for actors outside the project."

In contracts and permissions, special articles deal with the unknown, so called collateral clauses which are agreements between joint contractors to pool their guaranties in handling a large project. In the path of further preparation and processing of the project, as the contract states, "an optimal planning design" includes the plan for a completely new plan due to unexpected occurrences. Furthermore: "The parties involved agree that unforeseen risks need to be acknowledged."

Another important issue to successfully coordinate ecological remediation is the institutionalization of contacts and information exchange: i.e., regular consultations of all involved institutions and actors to exchange information, to discuss new developments and agree about strategies in adaptation to a new situation. Such consultations are not the norm in many projects that deal with known unknowns, since the official rhetoric still is that science delivers fully reliable results. This also means that all the actors involved must communicate their own ignorance, but not understood as failures but as a normal way of dealing with the unknown. This is exactly what happened in the remediation of the old industrial site in Weissandt-Gölzau. Disclosing the limits of knowing as a part of scientists' and engineers' communication with other stakeholders involved thus can be understood as an important step to experimentally bringing environmental projects to a successful end.

An interesting point in the remediation process at Weissandt-Gölzau is the relatively weak role of community representatives in the process. To be sure, elective officials representing the community were involved. However, the process could have more formally included by including neighborhood representatives and local citizen NGOs to represent the broader interests of the community – to foster greater accountability of project principals and stakeholders to the community at large – in addition to setting up an office where the public could visit and learn about the on-going remediation.

Outlook

The basic driving image behind experimentalism is to set up public experiments intentionally in order to increase reasoned deliberation about environmental problems. The basic formulation does not reject Habermas's notion of communicative rationality in the sense that it is also deeply committed to deliberation and reason giving. However the notion of experimentalism pushes the institutional debate about governance further than Habermas. In particular, we argue that deliberation and reason giving when connected to practical experimentation in which the results of experiments are publicly revealed, pooled, and compared leads to a stronger claim to socially rational governance because the notions of surprise and non-knowledge and the need for on-going reflection is taken into account.

Moving beyond lay-expert divides, much research in environmental sociology both in Europe as well as the US, has shown how new ways of experimenting in and with the natural ecosystem might look (cf. Moore 2006). However, acknowledging the surprising elements in processes of experimental governance, has not only challenged our understanding of the nature/society divide, but has led to the recognition that surprises in all human-nature interactions are the norm, which should become opportunities to learn rather than failures. Experimental governance thus needs a public that is ready to acknowledge uncertainty in all ecological practice, since the unexpected is part of living in nature. Thus people not only need to be ready to engage themselves, but also to take responsibilities for the sometimes surprising side-effects of their actions. This, of course, is not self-evident. In a political climate that fosters the belief in certainty through science, experiments in environmental governance will not work. By conscientiously intending to set up and learn from environmental policy experiments we can increase deliberate dialog about the environment, bring to bear practical tests to discipline the ideologies, and empower citizens in policy making and implementation. The hope of experimentalism is that the richer information an experimentalist regime generates will disentrench actors from their own routines of habit and mind.

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Chapter 17
Risk, Society and Environmental Policy: Risk Governance in a Complex World

Piet Sellke and Ortwin Renn

Abstract The notion "risk governance" refers to an integrated concept on how to deal with public risks in general, and so-called complex, ambiguous and uncertain risks in particular. It pertains to the complex whole of what traditionally has been called – and treated as separate activities – "risk assessment", "risk management", and "risk communication", After a short summary of the roots of risk governance, key concepts, such as simple, uncertain, complex and ambiguous risks, will be discussed. The main emphasis of this chapter will be on the five phases of risk governance: pre-assessment, appraisal, risk characterization/evaluation, risk management and risk communication. Rather than building coping capacity in proportion to the risks that one faces the new concept of risk governance demands an approach guided by resilience as well as virtual knowledge management and exchange. This includes the reduction of overall vulnerability and the introduction of a discourse-oriented management style. The paper will first provide some theoretical and conceptual thoughts on how to design risk management programs based on risk reduction, resilience and discourse.

Keywords Risk Governance • Risk Management • Risk Assessment • Risk Perception • Risk Evaluation

Introduction

In today's world of globalized trade, travel and communication, an ever larger number of risks have a trans-boundary impact, crossing national and regional frontiers: large-scale electricity blackouts, chemical accidents and risks related to

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emerging technologies have all affected various parts of the world only recently. Even these risks seem limited, however, when compared to those that can and do go global – and which, as a result of the rapid movement of people, goods and information, do so almost real-time. A highly topical example is that of the potential avian influenza epidemic; other examples include energy supply and price fluctuations and the political and psychological impacts of the 9/11 terror attacks.[1]

The International Risk Governance Council (IRGC) is currently developing a framework for risk governance to help analyze how society could better address and respond to such risks. To this end, the IRGC's framework maps out a structured approach which guides its user through the process of investigating global risk issues and designing appropriate governance strategies. This approach combines scientific evidence with economic considerations as well as social concerns and societal values and, thus, ensures that any risk-related decision draws on the broadest possible view of risk. The approach also states the case for an effective engagement of all relevant stakeholders.

The framework is currently being tested for efficacy and practicability – i.e. can the framework help ensure that all relevant issues and questions are being addressed, and, does it support the development of appropriate risk governance strategies. Tests are conducted in the form of short case studies applying the framework to different risks, including those related to genetically modified organisms, stem cells, nature-based tourism and the European gas infrastructure. The results from these tests will serve as input to any necessary revisions to the framework. The framework offers two major innovations to the risk field: the inclusion of the societal context and a new categorization of risk-related knowledge.

Inclusion of the societal context: Besides the generic elements of risk assessment, risk management and risk communication, the framework gives equal importance to contextual aspects which, either, are directly integrated in a model risk process as lined out below as well as additional elements or, otherwise, form the basic conditions for making any risk-related decision. Contextual aspects of the first category include the structure and interplay of the different actors dealing with risks, how these actors may differently perceive the risks and what concerns they have regarding their likely consequences. Examples of the second category include the policy-making or regulatory style as well as the socio-political impacts prevalent within the entities and institutions having a role in the risk process, their organizational imperatives and the capacity needed for effective risk governance. Linking the context with risk governance, the framework reflects the important role of risk-benefit evaluation and the need for resolving risk-risk trade-offs.

[1] This chapter and figures 17.1, 17.2, and 17.3 derived from two major documents: IRGC (International Risk Governance Council) (2005) *Risk Governance – Towards an Integrative Approach.* White Paper no 1. Authored by O. Renn with an Annex by P. Graham, IRGC, Geneva, and Renn O, Walker K (2008) Lessons learned: a re-assessment of the IRGC framework on risk governance. In: Renn O, Walker K (eds.) *The IRGC Risk Governance Framework: Concepts and Practice*. Springer, Heidelberg/New York, pp 331–367.

Categorization of risk-related knowledge: The framework also proposes a categorization of risk which is based on the different states of knowledge about each particular risk, distinguishing between 'simple', 'complex', 'uncertain' and 'ambiguous' risk problems. The characterization of a particular risk depends on the degree of difficulty of establishing the cause-effect relationship between a risk agent and its potential consequences, the reliability of this relationship and the degree of controversy with regard to both what a risk actually means for those affected and the values to be applied when judging whether or not something needs to be done about it. Examples of each risk category include, respectively, known health risks such as those related to smoking, the failure risk of interconnected technical systems such as the electricity transmission grid, atrocities such as those resulting from the changed nature and scale of international terrorism and the long-term effects and ethical acceptability of controversial technologies such as nanotechnologies. For each category, a strategy is then derived for risk assessment, risk management as well as the level and form of stakeholder participation, supported by proposals for appropriate methods and tools.

Scope of the Proposed Framework

This document covers a wide range of both risks and governance structures. *Risk* is understood in this document as an uncertain consequence of an event or an activity with respect to something that humans value (definition originally in Kates et al. 1985). Risks always refer to a combination of two components: the likelihood or chance of potential consequences and the severity of consequences of human activities, natural events or a combination of both. Such consequences can be positive or negative, depending on the values that people associate with them. IRGC is not covering all risk areas but confines its efforts to (predominantly negatively evaluated) risks that lead to physical consequences in terms of human life, health, and the natural and built environment. It also addresses impacts on financial assets, economic investments, social institutions, cultural heritage or psychological well-being as long as these impacts are associated with the physical consequences.[2] In addition to the strength and likelihood of these consequences, the framework emphasizes the distribution of risks over time, space and populations. In particular, the timescale of appearance of adverse effects is very important and links risk governance to sustainable development (delayed effects).

In this document we distinguish risks from hazards. Hazards describe the potential for harm or other consequences of interest. These potentials may never even materialize if, for example, people are not exposed to the hazards or if the targets

[2] Although the IRGC focuses on physical risks and their secondary implications, the framework may also be extended to allow for the investigation of financial, social or political risks as primary risk consequences.

are made resilient against the hazardous effect (such as immunization). In conceptual terms, hazards characterize the *inherent properties of the risk agent and related processes*, whereas risks describe the *potential effects that these hazards are likely to cause on specific targets such as buildings, ecosystems or human organisms and their related probabilities*.

Furthermore, IRGC places most attention on risk areas of global relevance (i.e. transboundary, international and ubiquitous risks) which additionally include large-scale effects (including low-probability, high-consequence outcomes), require multiple stakeholder involvement, lack a superior decision-making authority and involve the potential to cause wide-ranging concerns and outrage.

The IRGC has as one of its primary responsibilities the provision of expertise and practical advice in dealing with a novel type of risk, which the OECD has labeled ‘systemic risks’ (OECD 2003). This term denotes the embeddedness of any risk to human health and the environment in a larger context of social, financial and economic consequences and increased interdependencies both across risks and between their various backgrounds. Systemic risks are at the crossroads between natural events (partially altered and amplified by human action such as the emission of greenhouse gases), economic, social and technological developments and policy-driven actions, both at the domestic and the international level. These new interrelated and interdependent risk fields also require a new form of handling risk, in which data from different risk sources are either geographically or functionally integrated into one analytical perspective. Handling systemic risks requires a holistic approach to hazard identification, risk assessment, concern assessment, tolerability/acceptability judgments and risk management. Investigating systemic risks goes beyond the usual agent-consequence analysis and focuses on interdependencies and spill-overs between risk clusters.

Risk in a Broader Context

The focus on risk should be seen as a segment of a larger and wider perspective on how humans transform the natural into a cultural environment with the aims of improving living conditions and serving human wants and needs (Turner et al. 1990). These transformations are performed with a purpose in mind (normally a benefit to those who initiate them). When implementing these changes, intended (or tolerated) and unintended consequences may occur that meet or violate other dimensions of what humans value. Risks are not taken for their own sake; rather more they are, actively or passively, incurred because of their being an integral factor in the very activity that is geared towards achieving the particular human need or purpose. In this context, it is the major task of risk assessment to identify and explore, preferably in quantitative terms, the types, intensities and likelihood of the (normally undesired) consequences related to a risk. In addition, these consequences are associated with special concerns that individuals, social groups or different cultures may attribute to these risks. They also need to be assessed for making a prudent judgment about the tolerability or acceptability of risks. Once that judgment is made it is the task of risk management to prevent, reduce or alter these consequences by choosing appropriate actions. As obvious as this distinction between risk and concern assessment (as a tool of gaining knowledge about risks) and risk management (as a tool for handling risks) appears at first glance, the distinction becomes blurred in the actual risk governance process.

This blurring is due to the fact that assessment starts with the respective risk agent or source and tries to both identify potential damage scenarios and their probabilities and to model its potential consequences over time and space, whereas risk management oversees a much larger terrain of potential interventions (Stern and Fineberg 1996; Jasanoff 1986). Risk management may alter human wants or needs (so that the agent is not even created or continued). It can suggest substitutes or alternatives for the same need. It can relocate or isolate activities so that exposure is prevented, or it can make risk targets less vulnerable to potential harm. Risk assessment and management are therefore not symmetrical to each other: management encompasses a much larger domain and may even occur before assessments are performed. It is often based on considerations that are not affected by or part of the assessment results. In more general terms, risk management refers to the creation and evaluation of options for initiating or changing human activities or (natural and artificial) structures with the objective being to increase the net benefit to human society and prevent harm to humans and what they value. The identification of these options and their evaluation is guided by systematic and experiential knowledge gained and prepared for this purpose by experts and stakeholders. A major proportion of that relevant knowledge comprises the results of risk assessments. However, risk managers also need to act in situations of ‘non-knowledge’ or insufficient knowledge about potential outcomes of human actions or activities.

The most complex questions emerge, however, when one looks at how society and its various actors actually handle risk. In addition to knowledge gained through risk assessments and/or option generation and evaluation through risk management, the decision-making structure of a society is itself highly complicated and often fragmented. Apart from the structure itself – the people and organizations that share responsibility for assessing and managing risk – one must also consider the need for sufficient organizational capacity to create the necessary knowledge and implement the required actions, the political and cultural norms, rules and values within a particular societal context and the subjective perceptions of individuals and groups. These factors leave their marks on the way risks are treated in different domains and socio-political cultures. To place risk within a context of – sometimes closely interwoven – decision making structures such as those prevalent in governments and related authorities, in the corporate sector and industry, in the scientific community and in other stakeholder groups is of central concern to the IRGC.

In the last decade the term ‘governance’ has experienced tremendous popularity in the literature on international relations, comparative political science, policy studies, sociology of environment and technology as well as risk research. On a national scale, *governance describes structures and processes for collective decision making involving governmental and non-governmental actors* (Nye and Donahue 2000).

Governing choices in modern societies is seen as an interplay between governmental institutions, economic forces and civil society actors (such as NGOs). At the global level, *governance embodies a horizontally organized structure of functional self-regulation encompassing state and non-state actors bringing about collectively binding decisions without superior authority* (cf. Rosenau 1992; Wolf 2002). In this perspective non-state actors play an increasingly relevant role and become more important, since they have decisive advantages of information and resources compared to single states.

It is useful to differentiate between *horizontal and vertical governance* (Benz and Eberlein 1999; Lyall and Tait 2004). The horizontal level includes the relevant actors in decision making processes within a defined geographical or functional segment (such as all relevant actors within a community, region, nation or continent); the vertical level describes the links between these segments (such as the institutional relationships between the local, regional and state levels).

Risk governance involves the "translation" of the substance and core principles of governance to the context of risk and risk-related decision-making. In IRGC's understanding, risk governance includes the totality of actors, rules, conventions, processes, and mechanisms concerned with how relevant risk information is collected, analyzed and communicated and management decisions are taken. Encompassing the combined risk-relevant decisions and actions of both governmental and private actors, risk governance is of particular importance in, but not restricted to, situations where there is no single authority to take a binding risk management decision but where, instead, the nature of the risk requires the collaboration of and co-ordination between ranges of different stakeholders. Risk governance however not only includes a multifaceted, multi-actor risk process but also calls for the consideration of contextual factors such as institutional arrangements (e.g. the regulatory and legal framework that determines the relationship, roles and responsibilities of the actors and co-ordination mechanisms such as markets, incentives or self-imposed norms) and political culture, including different perceptions of risk.

When looking at risk governance structures there is no possibility of including all the variables that may influence the decision making process; there are too many. Therefore it is necessary to limit one's efforts to those factors and actors that, by theoretical reasoning and/or empirical analysis, are demonstrably of particular importance with respect to the outcome of risk governance. The IRGC has highlighted the following aspects of risk governance which extend beyond risk assessment and risk management:

- The structure and function of various actor groups in initiating, influencing, criticizing and/or implementing risk policies and decisions
- Risk perceptions of individuals and groups
- Individual, social and cultural concerns associated with the consequences of risk
- The regulatory and decision-making style (political culture)
- The requirements with respect to organizational and institutional capabilities for assessing, monitoring and managing risks (including emergency management)

In addition to these analytical categories, this document also addresses best practice and normative aspects of what is needed to improve governance structures and processes (European Commission 2001). With respect to best practice it is interesting to note that often risk creators, in particular when directly affected by the risk they generate, engage in risk reduction and avoidance out of self-interest or on a voluntary basis (e.g., industry 'gentleman's agreements', self-restriction, industry standards). Other stakeholders' efforts in risk governance therefore have to be coordinated with what is tacitly in place already. The emphasis here is on cooperative models of public-private partnerships forming a governance system that aims at effective, efficient and fair risk management solutions.[3]

The Risk Governance Framework

The framework's risk process, or risk handling chain, is illustrated in Fig. 17.1. It breaks down into three main phases: pre-assessment, appraisal, and management. A further phase, comprising the "characterization" and "evaluation" of risk, is placed between the appraisal and management phases and, depending on whether those charged with the assessment or those responsible for management are better equipped to perform the associated tasks, can be assigned to either of them – thus concluding the appraisal phase or marking the start of the management phase. The risk process has "communication" as a companion to all phases of addressing and handling risk and is itself of a cyclical nature. However, the clear sequence of phases and steps offered by this process is primarily a logical and functional one and will not always correspond to reality.

The Pre-Assessment Phase

Risks are *mental 'constructions'* (OECD 2003). They are not real phenomena, but originate in the human mind. Actors, however, creatively arrange and reassemble signals that they get from the 'real world' providing structure and guidance to an ongoing process of reality enactment. So risks represent what people observe in reality and what they experience. The link between risk as a mental concept and reality is forged through the experience of actual harm (the consequence of risk) in the sense that human lives are lost, health impacts can be observed, the environment

[3] Excluded from this document are such topics as crisis intervention, crisis communication, emergency planning and management and post-accidental relief. They will be covered in a separate document at a later stage.

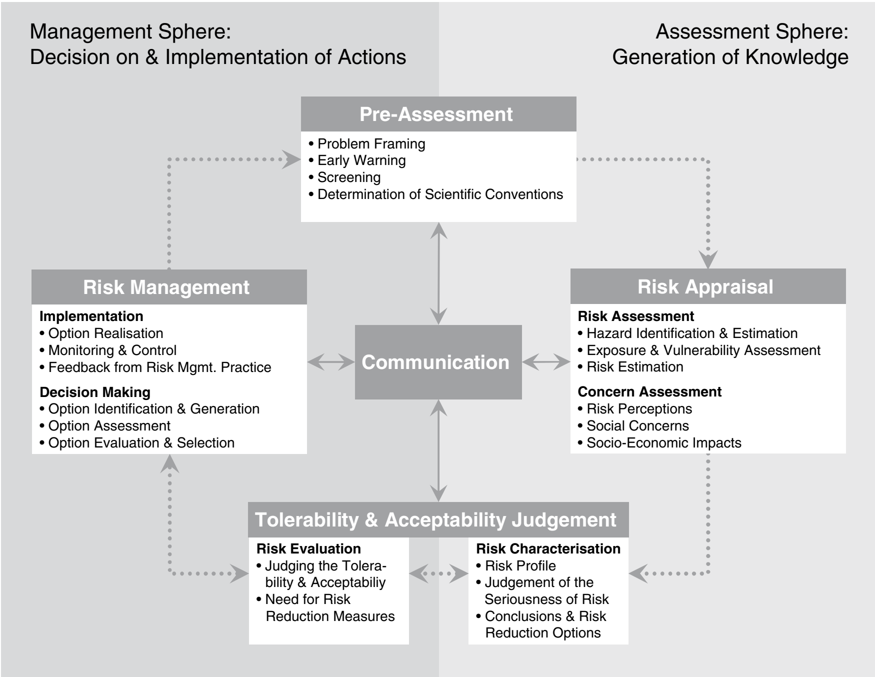

Fig. 17.1 The IRGC risk governance process

is damaged or buildings collapse. The invention of risk as a mental construct is contingent on the belief that human action can prevent harm in advance. Humans have the ability to design different futures, i.e. construct scenarios that serve as tools for the human mind to anticipate consequences in advance and change, within constraints of nature and culture, the course of actions accordingly.

The status of risk as a mental construct has major implications on how risk is looked at. Unlike trees or houses, one cannot scan the environment, identify the objects of interest and count them. Risks are created and selected by human actors. What counts as a risk to someone may be an act of God to someone else, or even an opportunity for a third party. Although societies have over time gained experience and collective knowledge of the potential impacts of events and activities, one cannot anticipate all potential scenarios and be worried about all the many potential consequences of a proposed activity or an expected event. By the same token, it is impossible to include all possible options for intervention. Therefore societies have been selective in what they have chosen to be worth considering and what to ignore (Thompson et al. 1990; Douglas 1990; Beck 1994).

Based on these preliminary thoughts, a systematic review of risk-related actions needs to start with an analysis of what major societal actors such as e.g. governments, companies, the scientific community and the general public select as risks and what types of problems they label as risk problems (rather than opportunities or innovation potentials, etc.). In technical terms this is called '*framing*'. The process of framing is already part of the governance structure since official agencies (for example food standard agencies), risk and opportunity producers (such as the food industry), those affected by risks and opportunities (such as consumer organizations) and interested bystanders (such as the media or an intellectual elite) are all involved and often in conflict with each other when framing the issue. What counts as risk may vary among these actor groups. Consumers may feel that all artificial food additives pose a risk, whereas industry may be concerned about pathogens that develop their negative potential due to the lack of consumer knowledge about food storage and preparation. Environmental groups may be concerned with the risks of industrial food versus organic food. Whether a consensus evolves about what requires consideration as a relevant risk depends on the legitimacy of the selection rule. The acceptance of selection rules rests on two conditions: first, all actors need to agree with the underlying goal (often legally prescribed, such as prevention of health detriments, or guarantee of an undisturbed environmental quality, for example purity laws for drinking water); secondly, they need to agree with the implications derived from the present state of knowledge (whether and to what degree the identified hazard impacts the desired goal).

A second part of the pre-assessment phase concerns the institutional means of *early warning and monitoring*. Even if there is a common agreement of what should be framed as (a) risk issue(s), there may be problems in monitoring the environment for signals of risks. This is often due to a lack of institutional efforts to collect and interpret signs of risk and deficiencies in communication between those looking for early signs and those acting upon them. The recent tsunami catastrophe in Asia provides a more than telling example of the discrepancy between the possibility of early warning capabilities and the decision to install or use them. It is therefore important to look at early warning and monitoring activities when investigating risk governance.

Another major component of pre-assessment is the *selection of conventions and procedural rules* needed for a comprehensive scientific appraisal of the risk, i.e. for assessing the risk and the concerns related to it (see below). Any such assessment is based on prior informed yet subjective judgments or conventions articulated by the scientific community or a joint body of risk assessors and managers. These judgments reflect the consensus among the experts or are common products of risk assessment and management (for example by licensing special testing methods). Their incorporation in guiding scientific analyses is unavoidable and this does not discredit the validity of the results. Yet it is essential that risk managers and interested parties are informed about these conventions and understand their rationale. On one hand, knowledge about these conventions can lead to a more cautious apprehension of what the assessments mean and imply, on the other hand they can convey a better understanding of the constraints and conditions under which the results of the various assessments hold true.

The following table provides a brief overview of the four components of the pre-assessment phase (Table 17.1).

Table 17.1 Components of pre-assessment in handling risks

	Pre-assessment components	Definition	Indicators
1	Problem framing	Different perspectives of how to conceptualize the issue	Dissent or consent on goals of selection rule Dissent or consent on relevance of evidence Choice of frame (risk, opportunity, fate)
2	Early warning	Systematic search for new hazards	Unusual events or phenomena Systematic comparison between modeled and observed phenomena Novel activities or events
3	Screening (risk assessment and concern assessment policy)	Establishing a procedure for screening hazards and risks and determining assessment and management route	Screening in place? Criteria for screening: • Hazard potential • Persistence • Ubiquity, etc. Criteria for selecting risk assessment procedures for: • Known risks • Emergencies, etc. Criteria for identifying and measuring social concerns
4	Scientific conventions for risk assessment and concern assessment	Determining the assumptions and parameters of scientific modeling and evaluating methods and procedures for assessing risks and concerns	Definition of no adverse effect levels (NOAEL) Validity of methods and techniques for risk assessments Methodological rules for assessing concerns

Risk Appraisal Phase

Risk appraisal includes the scientific assessment of the risks to human health and the environment and an assessment of related concerns as well as social and economic implications. The appraisal process is and should be clearly dominated by scientific analyses – but, in contrast to the traditional risk governance model, the scientific process includes both the natural/technical as well as the social sciences, including economics. We envision risk appraisal as having two process stages: firstly, natural and technical scientists use their skills to produce the best estimate of the physical harm that a risk source may induce (as described in the section on risk assessment below); secondly, social scientists and economists identify and analyze the issues that individuals or society as a whole link with a certain risk (as described in the section on concern assessment below). For this purpose the repertoire of the social sciences such as survey methods, focus groups, econometric analysis, macroeconomic modeling, or structured hearings with stakeholders may be used.

Risk Assessment

The purpose of risk assessment is the generation of knowledge, linking specific risk agents with uncertain but possible consequences (Lave 1987; Graham and Rhomberg 1996). The final product of risk assessment is an estimation of the risk in terms of a probability distribution of the modeled consequences (drawing on either discrete events or continuous loss functions).

As we have seen before, it is crucial to distinguish between hazards and risks. Correspondingly, *identification* (i.e. establishing cause-effect link) and *estimation* (determining the strength of the cause-effect link) need to be performed for hazards and risks separately. The estimation of risk depends on an exposure and/or vulnerability assessment. *Exposure* refers to the contact of the hazardous agent with the target (individuals, ecosystems, buildings, etc.). *Vulnerability* describes the various degrees of the target to experience harm or damage as a result of the exposure (for example: immune system of target population, vulnerable groups, structural deficiencies in buildings, etc.). In many cases it is common practice to combine hazard and risk estimates in scenarios that allow modelers to change parameters and include different sets of context constraints.

The basis of risk assessment is the systematic use of analytical – largely probability-based – methods which have been constantly improved over the past years. Probabilistic risk assessments for large technological systems, for instance, include tools such as fault and event trees, scenario techniques, distribution models based on Geographic Information Systems (GIS), transportation modeling and empirically driven human-machine interface simulations (IAEA 1995; Stricoff 1995). With respect to human health, improved methods of modeling individual variation (Hattis 2004), dose-response relationships (Olin et al. 1995) and exposure assessments (US-EPA 11.08.2005) have been developed and successfully applied. The processing of data is often guided by inferential statistics and organized in line with decision analytic procedures. These tools have been developed to generate knowledge about cause-effect relationships, estimate the strength of these relationships, characterize remaining uncertainties and ambiguities and describe, in quantitative or qualitative form, other risk or hazard related properties that are important for risk management (IAEA 1995; IEC 1993). In short, risk assessments specify what is at stake, calculate the probabilities for (un)wanted consequences, and aggregate both components into a single dimension (Kolluru 1995). The following table provides an overview on this phase (Table 17.2).

Risk assessment is confronted with three major challenges that can be best described using the terms ‘complexity’, ‘uncertainty’ and ‘ambiguity’. These three challenges are not related to the intrinsic characteristics of hazards or risks themselves but to the *state and quality of knowledge available* about both hazards and risks. Since risks are mental constructs, the quality of their explanatory power depends on the accuracy and validity of their (real) predictions. Unlike some other scientific constructs, validating the results of risk assessments is particularly difficult because, in theory, one would need to wait indefinitely to prove that the probabilities assigned to a specific outcome were correctly assessed. If the number of predicted events is frequent and the causal chain obvious (as is the case with car accidents),

Table 17.2 Generic components of risk assessment

	Assessment components	Definition	Indicators
1	Hazard identification and estimation	Recognizing potential for adverse effects and assessing the strength of cause-effect relationships	Properties such as flammability, etc.
			Persistence
			Irreversibility
			Ubiquity
			Delayed effects
			Potency for harm
			Dose-response relationships
2	Exposure/vulnerability assessment	Modeling diffusion, exposure and effects on risk targets	Exposure pathways
			Normalized behavior of target
			Vulnerability of target
3	Risk estimation	Quantitative: probability distribution of adverse effects	Expected risk value(s) (individual, collective)
		Qualitative: combination of hazard, exposure, and qualitative factors (scenario construction)	xx% confidence interval
			Risk description
			Risk modeling as function of variations in context variables and parameters

validation is relatively simple and straightforward. If, however, the assessment focuses on risks where cause-effect relationships are difficult to discern, effects are rare and difficult to interpret and variations in both causes and effects are obscuring the results, the validation of the assessment results becomes a major problem. In such instances, assessment procedures are needed to characterize the existing knowledge with respect to complexity, remaining uncertainties and ambiguities (WBGU 2000; Klinke and Renn 2002). *Complexity* refers to the difficulty of identifying and quantifying causal links between a multitude of potential causal agents and specific observed effects. The nature of this difficulty may be traced back to interactive effects among these agents (synergism and antagonisms), long delay periods between cause and effect, inter-individual variation, intervening variables, and others. *Uncertainty* is different from complexity but often results from an incomplete or inadequate reduction of complexity in modeling cause-effect chains. It is useful to distinguish between key components of uncertainty, such as target variability (based on different vulnerability of targets), systematic and random error in modeling (based on extrapolations from e.g., animals to humans), stochastic effects (variation due to random events), system boundaries (e.g., the need to focus on a limited amount of variables and parameters, and ignorance or non-knowledge (uncertainties derived from a lack of knowledge). *Ambiguity* as the third challenge of risk assessment is a result of divergent or contested perspectives on the justification, severity or wider 'meanings' associated with a given threat (Stirling 2003).

Concern Assessment

Since risk is a mental construct there is a wide variety of construction principles for conceptualizing risk. Different disciplines within the natural and social sciences have formed their own concepts of risk; stakeholder groups, driven by interest and experience, have developed their specific perspective on risk; and, last but not least, representatives of civil society as well as the general public are responding to risks according to their own risk constructs and images. These images are called '*perceptions*' in the psychological and social sciences and they have been intensely researched in relation to risk – as have their underlying factors (Covello 1983; Slovic 1987; Slovic et. al 1982; Boholm 1998; Rohrmann and Renn 2000). Risk perceptions belong to the contextual aspects that risk managers need to consider when deciding whether or not a risk should be taken as well as when designing risk reduction measures.

First of all it is highly important to know that human behavior is primarily driven by perception and not by facts or by what is understood as facts by risk analysts and scientists. Most cognitive psychologists believe that perceptions are formed by common sense reasoning, personal experience, social communication and cultural traditions (Brehmer 1987; Drottz-Sjöberg 1991; Pidgeon et al. 1992; Pidgeon 1998). In relation to risk it has been shown that humans link certain expectations, ideas, hopes, fears and emotions with activities or events that have uncertain consequences. People do, however, not use completely irrational strategies to assess information, but, most of the time, follow relatively consistent patterns of creating images of risks and evaluating them. These patterns are related to certain evolutionary bases of coping with dangerous situations. Faced with an eminent threat, humans react with four basic strategies: *flight, fight, play dead* and, if appropriate, *experimentation* (on the basis of trial and error).

In the course of cultural evolution the basic patterns of perception were increasingly enriched with cultural patterns. These cultural patterns can be described by so-called *qualitative evaluation characteristics* (Slovic 1992). They describe properties of risks or risky situations going beyond the two classical factors of risk assessment based on which risk is usually judged, i.e. level of probability and degree of possible harm. Here, psychologists differentiate between two classes of qualitative perception patterns: on the one hand *risk-related patterns*, which are based on the properties of the source of risk; on the other hand *situation-related patterns*, based on the idiosyncrasies of the risky situation (Fischhoff et al. 1978; Slovic 1987, 1992). Considered together these qualitative evaluation characteristics can be sub-divided into a limited number of consistent risk perception classes. In literature they are also called *semantic risk patterns.*

The most important policy question is how to treat risk perceptions in a policy arena that includes responses of different actors and the general public (Slovic et al. 1987; Fischhoff 1985, 1995). There are two suggestions from opposite ends. The first position states that only scientific concepts of risk claim inter-subjective validity and applicability. The second position states that there is no overarching universally applicable quality criterion available in order to evaluate the appropriateness or validity of risk concepts. The IRGC has strong reservations with respect to both positions. IRGC advocates an approach by which the elements of what matters to the different groups when they conceptualize risk should be regarded as equally legitimate factors for inclusion within risk governance (Gigerenzer and Selten 2001). This position has major impacts on risk policy making and communication. Policy making needs to, inter alia, organize systematic feedback from society and, equally, to include risk perceptions as an important input to deciding on whether something should be done about a certain risk and, if so, what (Jaeger et al. 2001).

Based on the results of risk assessment and the identification of individual and social concerns this second process stage also investigates and calculates *the social and economic implications of risks*. Of particular interest in this context are financial and legal implications, i.e. economic losses and liabilities, as well as social responses such as political mobilization.

Characterizing and Evaluating Risks

The most controversial part of handling risks refers to the process of delineating and justifying a judgment about the tolerability or acceptability of a given risk (HSE 2001). The term 'tolerable' refers to an activity that is seen as worth pursuing (for the benefit it carries) yet it requires additional efforts for risk reduction within reasonable limits. The term ‘acceptable’ refers to an activity where the remaining risks are so low that additional efforts for risk reduction are not seen as necessary.

To draw the line between ‘intolerable’ and ‘tolerable’ as well as ‘tolerable’ and ‘acceptable’ is one of the most difficult tasks of risk governance. The UK Health and Safety Executive has developed a procedure for chemical risks based on risk-risk comparisons (Löfstedt 1997). Some Swiss cantons such as Basle County experimented with Round Tables as a means to reach consensus on drawing the two lines, whereby participants in the Round Table represented industry, administrators, county officials, environmentalists, and neighborhood groups (RISKO 2000). Irrespective of the selected means to support this task, the judgment on acceptability or tolerability is contingent on making use of a variety of different knowledge sources. One needs to include the risk estimates derived from the risk assessment stage, and additional assessment data from the concern assessment within the appraisal stage.

Since the third of the above cases includes both of the other two, the process of judging the tolerability and acceptability of a risk can be structured into two distinct components: risk characterization and risk evaluation. The first step, *‘risk characterization’*, determines the evidence-based component for making the necessary judgment on the tolerability and/or acceptability of a risk; the step *‘risk evaluation’* determines the value-based component for making this judgment. *Risk characterization* includes tasks such as point estimates of risks, descriptions of remaining uncertainties (as undertaken for instance in climate change models or risk studies on endocrine disruptors and potential outcome scenarios including the social and economic implications, suggestions for safety factors to include inter-target variation, assurance of compatibility with legal prescriptions, risk-risk comparisons, risk-risk trade-offs, identification of discrepancies between risk assessment and risk perceptions as well as of potential equity violations, and suggestions for reasonable standards to meet legal requirements (Stern and Fineberg 1996). The second step, *risk evaluation*, broadens the picture to include pre-risk aspects such as choice of technology, social need for the specific risk agent (substitution possible?), risk-benefit balances, political priorities, potential for conflict resolution and social mobilization potential. The main objective here is to arrive at a judgment on tolerability and acceptability based on balancing pros and cons, testing potential impacts on quality of life, discussing different development options for the economy and society and weighing the competing arguments and evidence claims in a balanced manner.

The distinction between the three challenges of risk assessment, i.e. complexity, uncertainty and ambiguity, can also assist assessors and managers in assigning, or dividing, the judgment task. If a given risk is characterized by high complexity, low remaining uncertainties and hardly any ambiguities (except for interpretative differences over an established scientific risk assessment result), it is wise to let the assessment team dominate the process of making tolerability/acceptability judgments. If, in contrast, the risk is characterized by major unresolved uncertainties and if the results lead to highly diverse interpretations of what they mean for society, it is advisable to let risk managers take the lead (Table 17.3).

Table 17.3 Tolerability/acceptability judgment

	Assessment components	Definition	Indicators
1	Risk characterization	Collecting and summarizing all relevant evidence necessary for making an informed choice on tolerability or acceptability of the risk in question and suggesting potential options for dealing with the risk from a scientific perspective	
		(a) Risk profile	Risk estimates
			Confidence intervals
			Uncertainty measures
			Hazard characteristics
			Range of 'legitimate' interpretations
			Risk perceptions
			Social and economic implications
		(b) Judging the seriousness of risk	Compatibility with legal requirements
			Risk-risk trade-offs
			Effects on equity
			Public acceptance
		(c) Conclusions and risk reduction options	Suggestions for:
			Tolerable risk levels
			Acceptable risk levels
			Options for handling risks
2	Risk evaluation	Applying societal values and norms to the judgment on tolerability and acceptability and, consequently, determining the need for risk reduction measures	Choice of technology
			Potential for substitution
			Risk-benefit comparison
			Political priorities
			Compensation potential
			Conflict management
			Potential for social mobilization

Risk Management

Risk management starts with a review of all relevant information, in particular that from the combined risk appraisal, consisting of both a risk assessment and concern assessment whereby the latter is based on risk perception studies, economic impact assessments and the scientific characterization of social responses to the risk source. This information, together with the judgments made in the phase of risk characterization and evaluation, form the input material on which risk management options are being assessed, evaluated and selected.

At the outset, risk management is presented with three potential outcomes: intolerable situation (i.e. risk source needs to be abandoned or replaced or vulnerabilities need to be reduced and exposure restricted), tolerable situation (i.e. this means that the risks need to be reduced or handled in some other way within the limits of reasonable resource investments), or acceptable situation (this means that the risks are so small – perhaps even regarded as negligible – that any risk reduction effort is unnecessary). With regard to these outcomes risk managers may either face a situation of unanimity, i.e. all relevant actors agree with how a given risk situation should be qualified, or a situation of conflict in which major actors challenge the classification undertaken by others. The degree of controversy is one of the drivers for selecting the appropriate instruments for risk prevention or risk reduction.

If risks are classified as tolerable, or if there is dispute as to whether they are tolerable or acceptable, risk management needs to design and implement actions that make these risks acceptable over time. Should this not be feasible then risk management, aided by communication, needs at least to credibly convey the message that major effort is undertaken to bring these risks closer to being acceptable. This task can be described in terms of classic decision theory, i.e. in the steps shown in Table 17.4 (Morgan 1990; Keeney 1992).

Risk Management Strategies

Based on the distinction between complexity, uncertainty, and ambiguity it is possible to design generic strategies of risk management to be applied to classes of risks, thus simplifying the risk management process as outlined above. One can distinguish four such classes:

- *Linear risk problems*: This class of risk problems requires hardly any deviation from traditional decision making. Data is provided by statistical analysis, goals are determined by law or statutory requirements and the role of risk management is to ensure that all risk reduction measures are implemented and enforced. It should be noted, however, that simple risks should not be equated with small or negligible risks. The major issues here are that the potential negative consequences are obvious, the values that are applied are non-controversial and the remaining uncertainties low. Examples are car accidents, known food and health risks, regularly reoccurring natural disasters or safety devices for high buildings.
- *Complex risk problems*: For this risk class major input for risk management is provided by the scientific characterization of the risk. Complex risk problems are often associated with major scientific dissent about complex dose-effect relationships or the alleged effectiveness of measures to decrease vulnerabilities (for complexity refers to both the risk agent and its causal connections and the risk absorbing system and its vulnerabilities). The objective for resolving

Table 17.4 Generic components of risk management

	Management Components	Definition	Indicators
1	Option generation	Identification of potential risk handling options, in particular risk reduction, i.e. prevention, adaptation and mitigation, as well as risk avoidance, transfer and retention	Standards
			Performance rules
			Restrictions on exposure or vulnerability
			Economic incentives
			Compensation
			Insurance and liability
			Voluntary agreements
			Labels
			Information/education
2	Option assessment	Investigations of impacts of each option (economic, technical, social, political, cultural)	Effectiveness
			Efficiency
			Minimization of side effects
			Sustainability
			Fairness
			Legal and political implementability
			Ethical acceptability
			Public acceptance
3	Option evaluation and selection	Evaluation of options (multi-criteria analysis)	Assignment of trade-offs
			Incorporation of stakeholders and the public
4	Option implementation	Realization of the most preferred option	Accountability
			Consistency
			Effectiveness
5	Monitoring and feedback	Observation of effects of implementation (link to early warning)	Intended impacts
		Ex-post evaluation	Non-intended impacts
			Policy impacts

complexity is to receive a complete and balanced set of risk and concern assessment results that fall within the legitimate range of plural truth claims. It is, however, prudent to *distinguish management strategies for handling the risk agent* (such as a chemical or a technology) *from those needed for the risk absorbing system* (such as a building, an organism or an ecosystem). Addressing complex structures of risk agents requires methods for improving causal modeling and data quality control. With respect to risk absorbing systems the emphasis is on the improvement of *robustness* in responding to whatever the target is going to be exposed to.

- *Risk problems due to high unresolved uncertainty*: According to the IRGC, the management of risks characterized by multiple and high uncertainties should be guided by the precautionary approach. Since high unresolved uncertainty implies that the (true) dimensions of the risks are not (yet) known, one should pursue a cautious strategy that allows learning by restricted errors. The main management philosophy for this risk class is to allow small steps in implementation (containment approach) that enable risk managers to stop or even reverse the process as new knowledge is produced or the negative side effects become visible. The primary thrust of precaution is to avoid irreversibility (Klinke and Renn 2002).
- *Risk problems due to normative or interpretative ambiguity*: If risk information is interpreted differently by different stakeholders in society – i.e. there are different viewpoints about the relevance, meaning and implications of factual explanations and predictions for deciding about the tolerability of a risk as well as management actions – and if the values and priorities of what should be protected or reduced are subject to intense controversy, risk management needs to address the causes for these conflicting views (Von Winterfeldt and Edwards 1984).

Table 17.5 summarizes the management strategies suggested for each risk class, as well as examples of appropriate instruments.

Our emphasis on governance rather than governments or administrations is meant to underline the importance that IRGC places on the inclusion of stakeholders and public groups within the risk handling process and, consequently, on the establishment of adequate public-private partnerships and participatory processes. In the context of this framework we define *stakeholders* as socially organized groups that are or will be affected by the outcome of the event or the activity from which the risk originates and/or by the risk management options taken to counter the risk. Involving stakeholders is not enough, however. Other groups, including the media, cultural elites and opinion leaders, the non-organized *affected* public and the non-organized *observing* public, all have a role to play in risk governance.

In this respect, the four risk classes (simple, complex, high uncertainty and high ambiguity) presented above support generic suggestions for participation. Figure 17.2 provides an overview of the different requirements for participation and stakeholder involvement for the four classes of risk problems and the design discourse. As is the case with all classifications, this scheme shows an extremely simplified picture of the involvement process and it has been criticized for being too rigid in its linking of risk characteristics (complexity, uncertainty, and ambiguity) and specific forms of discourse and dialog (Van Asselt 2005). In addition to the generic distinctions shown in the below graph, it may for instance be wise to distinguish between participatory processes based on risk agent or risk absorbing issues. To conclude these caveats, the purpose of this scheme is to provide general orientation and explain a generic distinction between ideal cases rather than to offer a strict recipe for participation.

Table 17.5 Risk characteristics and their implications for risk management

	Knowledge characterization	Management strategy	Appropriate instruments	Stakeholder participation
1	Linear risk problems	Routine-based: (tolerability/ acceptability judgment)	Applying 'traditional' decision-making:	Instrumental discourse
			Risk-benefit analysis, risk-risk trade-offs	
		(risk reduction)	Trial and error	
			Technical standards	
			Economic incentives	
			Education, labeling, information	
			Voluntary agreements	
2	Complexity-induced risk problems	Risk-informed: (risk agent and causal chain)	Characterizing the available evidence	Epistemic discourse
			Expert consensus seeking tools: • Delphi or consensus conferencing • Meta analysis • Scenario construction, etc. • Results fed into routine operation	
		Robustness-focused: (risk absorbing system)	Improving buffer capacity of risk target by:	
			• Additional safety factors • Redundancy and diversity in designing safety devices • Improving coping capacity • Establishing high reliability organizations	

3	Uncertainty-induced risk problems	Precaution-based: (risk agent)	Using hazard characteristics such as persistence, ubiquity etc. as proxies for risk estimates Tools include: • Containment • ALARA (as low as reasonably achievable) and ALARP (as low as reasonably possible) • BACT (best available control technology)	Reflective discourse
		Resilience-focused: (risk absorbing system)	Improving capability to cope with surprises • Diversity of means to accomplish desired benefits • Avoiding high vulnerability • Allowing for flexible responses • Preparedness for adaptation	
4	Ambiguity-induced risk problems	Discourse-based:	Application of conflict resolution methods: for reaching consensus or tolerance for risk evaluation and management • Integration of stakeholder involvement in reaching closure • Emphasis on communication and social discourse	Participative discourse

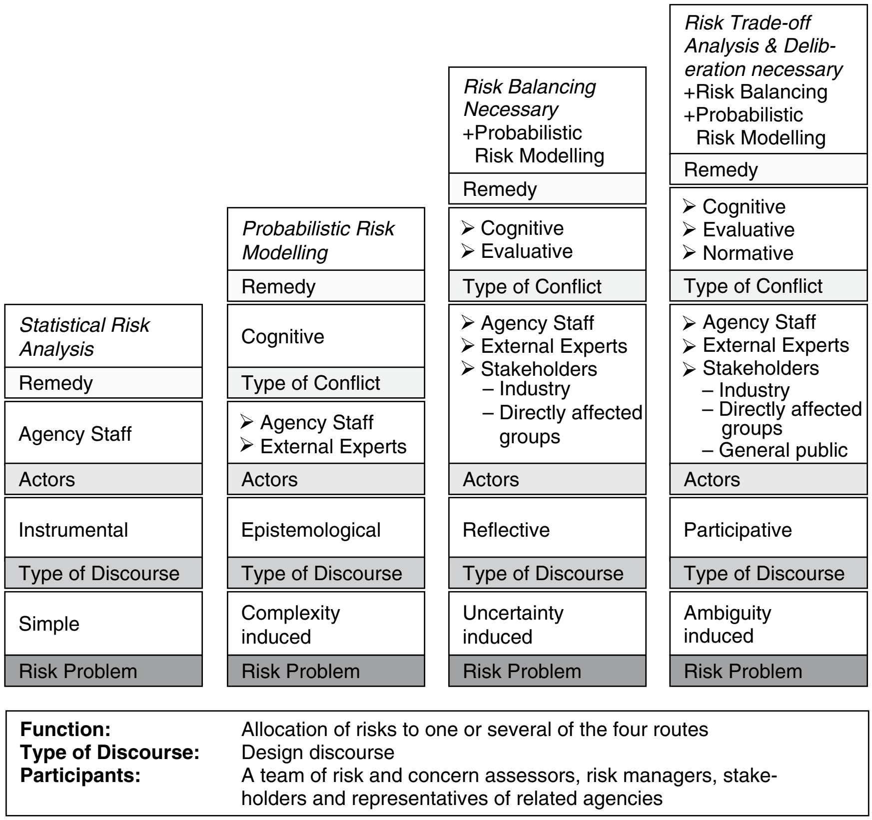

Fig. 17.2 The risk management escalator and stakeholder involvement

Risk Communication

Given the arguments about risk perception and stakeholder involvement, the IRGC believes strongly that effective communication has to be at the core of any successful activity to assess and manage risks. Risk communication is needed throughout the whole risk handling chain, from the framing of the issue to the monitoring of risk management impacts. The precise form of communication needs to reflect the nature of the risks under consideration, their context and whether they arouse, or could arouse, societal concern. Communication has to be a means to both ensure that:

- Those who are central to risk framing, risk appraisal or risk management understand what is happening, how they are to be involved, and, where appropriate, what their responsibilities are, and
- Others outside the immediate risk appraisal or risk management process are informed and engaged

Effective communication, or the non-existence thereof, has a major bearing on how well people are prepared to face and cope with risk. Limited knowledge of, and involvement in, the risk management process can lead to inappropriate behavior in emergency or risk-bearing situations (for example, when facing a pending flood or handling contaminated food or water). There is also the risk of failed communication: consumers or product users may misread or misunderstand risk warnings or labels so that they may, through ignorance, expose themselves to a larger risk than necessary.

Although risk communication implies a stronger role for risk professionals to provide information to the public rather than vice versa, it should be regarded as a mutual learning process. Concerns, perceptions and experiential knowledge of the targeted audience(s) should thus guide risk professionals in their selection of topics and subjects: it is not the task of the communicators to decide what people need to know but to respond to the questions of what people want to know (cf. Baram 1984).

Wider Governance Issues

When considering the wider environment of risk handling in modern societies, many classes of influential factors come into play. Only a few can be mentioned here. For example, the distinction between horizontal and vertical governance as introduced in the first section of this document can be helpful in describing and analyzing cases of risk handling in different countries and contexts (Zürn 2000). In addition, the interplay between economic, political, scientific and civil society actors needs to be addressed when looking beyond just governmental or corporate actions. Further, looking at organizational capacity opens a new set of wider risk governance issues which relate to the interplay between the governing actors and their capability to fulfill their role in the risk governance process. It is the goal of the IRGC to focus particularly on risk areas which have multidimensional and transnational implications, rather than revisiting classic areas of risk regulation by individual governments or routine risk handling by private corporations.

Figure 17.3 shows external influencing factors that cannot be placed within the risk framework itself. Additionally, case studies analyzed by the IRGC are placed within this figure.

Whereas the risk of listeria can be resolved completely within the core risk governance framework, it is different for the issue of gas transportation from Russia to Western countries. Here the question can be posed in terms of tolerability within the framework, and additionally in terms of organizational capacity outside of the core risk governance framework. The case studies of acrylamide shows a strong dependency of this issue on the cooperation of different societal actors. Finally, the case of genetically modified organisms (GMO) shows how the social climate and the political culture influence this process.

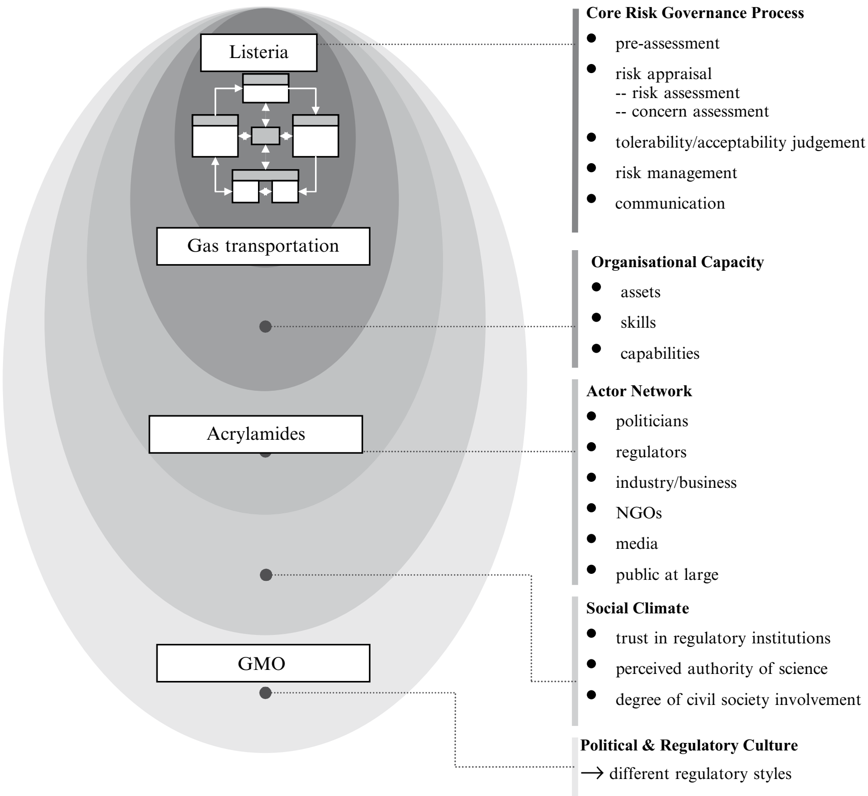

Fig. 17.3 Wider governance issues

Conclusions

One of the main mandates of the IRGC is to assist risk/concern assessors and managers in exploring and handling risks and to promote effective and fair approaches for improving, and enhancing the visibility of, the present risk governance processes. IRGC's aim is to offer guidance and advice on how to approach the complexities, uncertainties and ambiguities of risk issues and to promote a wider understanding of their interconnectedness and transgressional nature, particularly in relation to newly emerging systemic risks. To this end the IRGC is developing an integrative framework that takes into account scientific, physical, economic, social and cultural aspects and includes effective and appropriate engagement of stakeholders – not least to ensure that both risk appraisal and risk management strategies command the widest possible acceptance and support. A prototype version of this framework is outlined in the present paper and summarized in Fig. 17.1.

The framework has been designed, on one hand, to include enough flexibility to allow its users to do justice to the wide diversity of risk governance structures and, on the other hand, to provide sufficient clarity, consistency and unambiguous orientation across a range of different risk issues and countries.

This document, firstly, discussed a comprehensive risk handling chain, breaking down its various components into three main phases: ‘pre-assessment’, ‘appraisal’, and ‘management’. The two intermediate and closely linked stages of risk characterization and evaluation have been placed between the appraisal and management phases and can be assigned to either of them, depending on the circumstances: if the interpretation of evidence is the guiding principle for characterizing risks, then risk and concern assessors are probably the most appropriate people to handle this task; if the interpretation of underlying values and the selection of yardsticks for judging acceptability are the key problems, then risk managers should be responsible. In an ideal setting, however, this task of determining a risk’s acceptability should be performed in a joint effort by both assessors and managers. At any rate, a comprehensive, informed and value-sensitive risk management process requires a systematic compilation of results from risk assessment, risk perception studies and other context-related aspects as recommended and subsumed under the category of risk appraisal. Risk managers are thus well advised to include all the information related to the risk appraisal in evaluating the tolerability of risks and in designing and evaluating risk reduction options. The crucial task of risk communication runs parallel to all phases of handling risk: it assures transparency, public oversight and mutual understanding of the risks and their governance.

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Chapter 18
Climate Change and Society – Communicating Adaptation

Harald Heinrichs

Abstract This article presents a theoretical-conceptual approach for the communication of societal adaptation to the consequences of global climate change. Next to the dominating issues of prevention and mitigation (e.g. reduction of CO_2 emissions) as well as restoration (e.g. reforestation) there is a growing awareness of the need for adaptation. Because of the societal and factual complexity of adaptation strategies, communication has a pivotal role to play. However, so far there has been too little done to conceptualize and analyze adaptation-oriented communication. Based on established approaches – disaster, risk and sustainability communication – the integrative concept of 'adaptation communication' is developed and discussed.

Keywords Climate change • Adaptation • Disaster • Risk • Sustainability and communication

Introduction

This article presents a theoretical-conceptual approach for the communication of societal adaptation to the local and regional consequences of global climate change. In the first part I discuss why adaptation is a challenge for societal communication. Next to the dominating issues of prevention and mitigation (e.g., reduction of CO_2 emissions) as well as restoration (e.g., reforestation) in the discourse and practice of sustainable development, there is a growing awareness of the need for adaptation (e.g., IPCC 2007; Adger 2006a, b; Stern 2006). Because of the societal and factual complexity of adaptation strategies, communication has a pivotal role to play.

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However, so far there has been too little done to conceptualize and analyze adaptation-oriented communication. Based on established approaches – disaster, risk and sustainability communication – I develop the integrative concept of 'adaptation communication' in the second part of the paper. At the end I discuss what relevance this approach may have for the science and praxis of global environmental change and its regional and local challenges for adaptation.

Mitigation, Restoration, Adaptation: Challenges for Communication

When the normative-analytical framework of sustainable development entered the world stage at the conference for "Environment and Development" in Rio de Janeiro in 1992 the main goal was the co-optimization of ecological, social and economic challenges with a special focus on intra- and intergenerational justice (Agenda 21). The magnitude of the challenge, especially climate change, was and is so large that the transition to sustainable development demands a search, learning and decision-making process in which a broad range of stakeholders and the public at large has to become involved (Loorbach 2007; Voss et al. 2006; Lafferty 2004). Technocratic sustainability management is generally not seen as sufficient. Political steering by regulation and market incentives has to be accompanied by discursive (learning) processes in order to raise awareness and develop new social practices and so stimulate societal (self-)transformation towards sustainability (Wals 2007). Three arguments are central for the claim that more communication and participation is needed (Heinrichs 2005a; Renn and Webbler 1998): From a functional-analytic perspective we can note that in order to effectively put its political agenda into practice in highly differentiated, pluralistic societies the state is increasingly dependent on non-governmental economic and civil society actors and their specific possibilities to exert influence as well as citizens with their local action competences. And from an ethical-normative perspective it is in principle a good thing when as many people as possible take part in decision-making that shapes their lives. Thirdly, we should not overlook the fact that the Rio Conference took place at a time after the collapse of communism when market economy and democracy advanced to a world-wide model and (neo-) liberalism started a global process of privatization (Fukuyama 1992). Between the failure of the state due to growing social complexity (pluralization, individualization) and politically willed privatization (globalization, de-bureaucratization), citizens and civil society actors need to be granted more participatory rights and obligations. The manifold scientific and political discourses on governance, civil society, participatory democracy and the like reflect the guiding vision of sustainable development as a societal transformation process, in which political steering, economic market mechanisms as well as civic self-organization and coordination are needed (e.g., Biermann 2007; Folke et al. 2005; Edwards 2004; Kjaer 2004; Bohman 1996; Barber 1984).

During the 15 years since the Rio Conference there have been significant activities for sustainable development on different levels (local, national, regional, international) and in different arenas (science, policy-making, business, civil society, (higher) education up to the mass media). The main focus so far was and is on reducing societal impact on the environment (prevention/mitigation). This field of analysis and action focuses on man-made environmental degradation and solutions. The aim is to reduce adverse societal impacts on the bio-physical environment. This perspective is reflected in approaches such as sustainable production and consumption or ecological modernization more generally (Spargaaren 2004; Mol and Sonnenfeld 2000). With regard to climate change, the whole field of climate protection, especially the reduction of CO_2 emissions, belongs to this dominating perspective. The Kyoto Protocol is internationally the most important instrument to reduce anthropogenic impact on the global climate.

Alongside prevention and mitigation there have been a growing number of initiatives which aim at re-constructing environmental functions (Higgs 2003). Environmental degradation of water, soil and air as well as ecological systems in general, caused by 'normal' production and consumption processes, accidents such as oil spills, brownfields or deforestation may be countered with environmental or ecological restoration activities: reforestation, brownfield clean-ups, river re-naturalization, water recycling etc. are all examples of activities to reconstruct previously degenerated environmental functions. The focus here is not the 'nature-identical' reproduction but a reconstructive 'nature by design' based on (pluralistic) human knowledge, interests and values (Gross 2003).

With regard to climate change, reforestation projects to bind more CO_2 and thereby contribute to climate protection have gained in importance, especially in compensation projects. Next to these mitigation-oriented restoration projects, there is a growing need for the reconstruction of environmental functions as a consequence of environmental degradation caused by global environmental change. Along with processes such as urbanization or land cover change, climate change affects ecosystems significantly (Millennium Ecosystem Assessment 2005). The spectrum of adaptation-oriented restoration projects range from more storm-resistant mixed forests instead of mono cultures up to measures to combat desertification or strengthen ecosystems such as mangroves as a means for coastal protection. These reactive activities are growing in relevance because prevention and mitigation of societal impact on the life-supporting system have so far not been as successful as they should have been. Even though some progress has been made in environmental protection (McNeill 2003) the general trends of global civilization are still unsustainable (Steffen et al. 2004).

Recent scientific and policy-oriented publications agree that bio-physical systems, especially the climate system, are significantly and irreversibly disturbed (IPCC 2007). Anthropogenic climate change is affecting the world and because of the delayed effects in these highly complex systems we have to prepare for significant climate change within the next few decades. Successful mitigation has only been able to reduce but not prevent anthropogenic climate change. Therefore the issue of adaptation as a means of reducing vulnerability and strengthen resilience is now as important as the approaches of prevention/mitigation and restoration to promoting sustainable development (Adger 2006a, b; Berkes et al. 2003; Kasperson 2001).[1]

Similar to mitigation and restoration strategies for sustainable development, adaptation to climate change is a factually and socially complex process as well. It is factually complex, because the knowledge to anticipate and assess concrete local and regional consequences of global climate change remains uncertain – at least in the sense of (quantitative) risk management (Kasperson et al. 1995; Renn et al. 2007). On the one hand this is due to the inherent knowledge limitations of climate change scenarios. On the other hand societal vulnerability, which should be reduced by adaptation measures, is influenced by factors other than climate change. As disaster research has shown, it is a multifactor phenomenon depending on geographical exposure, socio-economic conditions and coping capacities (Turner et al. 1995; Olmos 2001; Torry 1979; Susman et al. 1983; Kreps 1989; Kates 1994). Adaptation to climate change is socially complex, because of its ambiguity in normative interpretations regarding the general need for adaptation. This uncertainty in knowledge opens up room for value and interest-laden evaluations regarding questions such as: To what extent, for what price and how fast do we have to adapt? However, the issue is pressing not only because climate change has started to affect societies. Probably more important is the fact that many adaptation measures will be oriented towards the built environment, where for example changes in infrastructure, such as dikes, take 20–30 years from planning till implementation (Schuchardt and Schirmer 2007). That means decisions which are made today and which do not include the perspective of adaptation may cause future disasters. Given the fact that (most) societies nowadays are more or less pluralistic with regard to values, interests, knowledge claims and power resources and are characterized by varying degrees of socio-ecological inequality, there is a growing need for societal self-understanding about the need for adaptation.

The expected consequences of climate change are varied. Extreme weather events such as heat waves, drought, flooding, the slow rise in sea level, melting glaciers and polar icecaps require adaptation measures in many sectors of society, including agriculture, tourism, residential and city planning, the insurance industry and especially in flooding and coastal protection (IPCC 2007; Stern 2007). It is crucial to ensure that the adaptation measures themselves are sustainable so as not to be part of the problem they are supposed to solve. Since adaptation to global climate change aims at reducing vulnerability and strengthening resilience, a goal-oriented *adaptation communication* becomes urgent.

[1] The broader discourse on adaptive governance of social-ecological systems has produced basic insights about the complexity and dynamics of society-environment interactions and the need for accepting ongoing change and the ability to proactively shape change (e.g., Folke et al. 2005). In these research activities, which are centered on co-management of ecosystems, the relevance of governance, stakeholder involvement, social capital, actor networks and social learning is emphasized as key for adaptive governance. Against this background this article adds to this perspective by focusing specifically on communication processes for adaptation to climate change.

In recent publications on climate change communication the main focus is clearly on communicating social change for reducing societal impact on the environment, specifically the climate system (prevention/mitigation) (Moser et al. 2007). Similar to this analytical perspective, the communicative complexity of which is obvious, we need to better understand the specific nature of communicating adaptation. Even though some challenges in both perspectives of climate change communication are very similar, such as the need for broad involvement of stakeholders and the public at large or the improvement of science-policy communication to increase the awareness and capacity building of decision-makers, there are some distinctive features in communication for adaptation which call for a specific theoretical-conceptual approach.

Communicating Adaptation: An Integrative Framework

In order to develop a theoretical-conceptual framework for the communication of challenges to and measures for adaptation to global environmental change we do not have to start from scratch. Three approaches of social sciences and communication sciences seem to be of special relevance: disaster communication, risk communication and sustainability communication. In the following we will give an overview of the central insights of these approaches and then connect them within the concept of 'adaptation communication'. This approach has been developed within a research project on climate change, flood risk and coastal protection at the German North Sea coast, where the focus was on communication processes with regard to disaster, risk and adaptation (Heinrichs and Grunenberg 2007). As recent studies have shown, flooding, especially in coastal zones, is an increasing risk and therefore an interesting field to apply the approach of 'adaptation communication' (Plate and Merz 2001; Vereinte Nationen 2000; WBGU 1998; Münchener Rück 2006; IHDP 2007). Despite the specific origin of the integrative framework, the approach aims at providing a general perspective on communicating adaptation in the context of global environmental change.

Disaster Communication

In disaster management there are three distinct phases: prevention, acute crisis and recovery (Plate and Merz 2001). In each phase there is a need for communication both among the institutions responsible for providing disaster protection as well as with the affected population. We will focus in this article on the most important aspect of the relationship we are studying, the external communication of the responsible actors for disaster protection as well as on the social and individual importance of disaster communication.

The goal of (state) disaster and crisis communication is for the public to behave appropriately in a disaster or crisis, e.g., taking preventive measures or following a call to evacuate. Reaching this goal however involves fulfilling a great number of conditions. Communication is, as we know from numerous studies, not a simple linear process in which a sender (disaster protection authorities) sends a message which is received by a recipient (the public) and transformed into appropriate action. Communication is rather a social process in which factors such as the credibility of the communicator plays as much of a role as the selection and interpretation of information by the recipients (Ruhrmann and Kohring 1996: 15). For the development of adequate disaster communication we need findings from research into natural disaster perception and behavior.

Especially in the English-language literature there is a great number of social science studies analyzing perception and action in relationship to the three disaster phases – prevention, acute, recovery (see Tobin and Montz 1997; Grothmann 2005). Even though some of the analyses come to different results, we can still identify a number of basic patterns and tendencies that are important for disaster communication.

Natural disaster perception and behavior are, following Tobin and Montz (1997: 149), influenced by situational (physical and socio-economic environment) and cognitive dimensions (psychological variables and attitude variables). Perception and behavior will thus differ depending on whether one lives close to a river or far away (physical environment), whether one is rich or poor (socio-economic environment), whether one knows much or little about flooding risks (psychological variable) or whether one sees nature as incalculable or fragile (attitude variable). If we add to this basic perception and behavior model a further emotional-physical dimension (Grothmann 2005: 51; Tobin and Montz 1997: 155) (e.g., anxiety, hindrance) we have a useful orientation framework for the analysis of natural disaster perception and behavior and the design of disaster communication. The following overview summarizes important research findings in the three dimensions.

Situational Dimension

Although human action is not determined by the bio-physical environment, local conditions are still important factors which influence perception and behavior (see Tobin and Montz 1997: 155 ff): Collective and individual experiences of the environment lead to reactions, for example based on experiences of flooding, coastal defense associations have built up dikes and developed coping strategies. However such studies also show that the intensity and frequency of events are of central importance to protective actions: the rarer an event is, the worse individuals are able to deal with it. When individuals are confronted with an event more frequently then they are more likely to take protective actions (e.g., taking out insurance policies). A direct experience of a disaster however does not necessarily lead to a better protective action: repressive mechanisms can lead to the conviction that something so bad cannot happen again; actions are not adapted to the changed risk situation; the memory of the consequences of the disaster begins to pale.

In order to better understand why societies react differently to similar disaster situations, we need to look at socio-economic and demographic variables. These include a number of aspects: age, education, income, marital status, social, political and cultural context etc. We are relatively certain (cf. Tobin and Montz 1997; Grothmann 2005) that greater income and level of education increase disaster prevention because the possibilities of taking action are better: apartment and house owners are more likely to take precaution than renters; this is also true for people who have lived for a longer period of time in an endangered area; families are more aware of disaster protection programs than single households; social networks play an important role in disaster situations and their aftermath; the political and cultural context helps determine whether disasters are considered "force majeure" or as socially shaped.

Alongside these factors, we should add that in modern societies the (mass) media is an important context condition (Ruhrmann and Kohring 1996: 76 ff). Media reporting is relevant as both an information channel and a communication arena: in the media there are discussions about potential disasters and the possibilities for taking action; in the acute phase particularly radio and television are important for spreading warnings; and in the aftermath discussions about blame and responsibility as well as information about aid are disseminated. Disaster definitions are communicated through the mass media according to the specific logic of the media and influence individual and collective perceptions. We should not overestimate the effect of media as recipients, who, depending on their experiences, knowledge and attitudes, process the contents of media messages selectively and interpretively (Peters and Heinrichs 2005: 158 ff).

Cognitive Dimension

Since humans do not have immediate access to the "world", perception and behavior are mediated cognitively and emotionally. Genetic predisposition interacts with both the social and physical environment to create individual characteristics which shape our perception of nature and our behavior towards it. People with different life biographies react differently to the same event. Psychological characteristics such as information processing capacities or controllability beliefs as well as value orientations and attitudes shape disaster behavior. These cognitive predispositions act as filters for natural disaster perception.

In general there are three different disaster perception models (Smith 2001): deterministic perception, dissonant perception and probabilistic perception. Deterministic perception attempts to interpret an ordering pattern into the randomness of disasters; a saying for example that "floods come every seven years". Dissonant perception attempts to repress potential disasters. Disasters are seen as either improbable or existing protective measures are seen as guaranteeing absolute protection. Probabilistic perception comes closest to the reality of disasters as it considers the probability of an occurrence and the extent of damage. The assessment of risk is however often incorrect. In addition it often involves a delegation of responsibility, which in the case of the event leads to blame being assigned to state institutions.

Alongside these ideal-typical perception patterns, an individual's value orientations and attitudes are relevant, including his/her basic understanding of nature as well as attitudes towards the political system. There is a difference whether one has an image of nature as something benevolent or as something to be tamed and whether one considers disaster protection authorities as competent or not.

Emotional-Physical Dimension

Along with situational and cognitive conditions there are also emotional factors like anxiety or stress susceptibility and physical factors like personal mobility and health (Tobin and Montz 1997: 155; Grothmann 2005: 51 ff). Physical characteristics, like a physical handicap, can for example restrict an individual's possibilities to act in disaster situations. And depending on the emotional predisposition post-traumatic stress disorder after a disaster can be either stronger or weaker. And even disaster prevention measures can trigger stress for individuals. The relevance of emotional-physical factors for natural disaster perception and behavior has however been relatively little researched (Grothmann 2005: 55).

In summary we can say that significant local and regional variability of bio-physical and socio-economic situational conditions as well as individual cognitive and emotional-physical characteristics are the basis for the heterogeneous perception of natural disasters and behavior by a population. Individual prevention, acute crisis and recovery behavior as well as collective state disaster management, which must be legitimated and accepted by individuals, is thus dependent on a large number of intervening variables. Disaster communication faces demanding requirements.

Like every communication act, disaster or crisis communication is a social process. That means that communication is shaped by and through content, and by the nature of the relationship between the communication participants, in our case between state and citizen. A decisive factor for the acceptance of information and communication effectiveness is thus the credibility of the communicator and the trust shown him or her. The success of disaster and crisis communication is dependent on trust that must be continually earned. Hierarchically structured communication relationships, in which expert-based information is given by the state to the population with the goal of educating it, would thus appear insufficient (Ruhrmann and Kohring 1996: 60).

Alongside classic instruments like (written) information prevention campaigns, such as early warnings and forecasts, which are considered to be only minimally effective, even though they are especially important for predictable extreme events like floods and radio and television used for disseminating information during acute crisis events, interactive and participation-oriented approaches have become more prevalent. The spectrum ranges from the participative design of emergency and evacuation plans and disaster protection exercises to the initiation and promotion of social networks for individual self-organization (Ruhrmann and Kohring 1996: 44;

Grothmann 2005: 214). Individually conceived civil and disaster protection is considered necessary in order to link expert knowledge to local experiences and competences (Dombrowsky 1991). This allows the public during a disaster, until now largely passive, to become active, responsible partners of professional disaster prevention actors. These analyses and conceptual designs are part of a change process in the relationship between the state and an active civil society.

For disaster and crisis communication, the findings of natural disaster perception research as well as the analyses of communication theory mean that diversified communication strategies are necessary. As far as disaster prevention is concerned, targeted information campaigns aimed at specific population groups (e.g., migrants) are necessary on the one hand. At the same time risk information should be coupled with possibilities to act in order to prevent feelings of anxiety and fatalism (Grothmann 2005: 215). Continuous media communication is a building block in this phase in order to keep disaster awareness in the social discussion (Peters and Reif 2000: 75 ff). It is important to take into account the selection criteria specific to journalism, and to build long-term networks between journalists and disaster protection authorities. A further building block is dialog and participation-oriented approaches, which make use of the local experiences and needs of individuals in disaster protection strategies and mobilize self-initiative and self-organization. Finally, it also appears meaningful to introduce the topic into the school curriculum in order to increase a responsible attitude toward disasters in society over the long term. In the acute crisis phase, functional early warning and forecast systems, especially involving mass media such as TV and radio, are of central importance. Information must be transmitted in a clear, comprehensible and targeted way to the public. The extent to which this information can then be processed adequately by the public depends largely on the disaster awareness of individuals, which must be developed before the event occurs. In addition, in this phase there must be an adequate communication strategy for the coordination of state, civil and private protection actions. One element in the disaster recovery phase is the communication of offers of aid, for example, professional communication offerings to reduce post-traumatic stress disorder or possibilities regarding damage compensation. On the other hand, in this phase the media begin to convey social communication about responsibility, wrongful behavior and consequences. This places high demands on disaster and crisis communication, whose success depends to a great degree on the quality of the interaction relationship built up over the long term between disaster protection, individuals and the media (Dombrowsky 1991). This involves, along with disaster communication narrowly defined, a broader communication about the risk situation in which society finds itself.

Risk Communication

Risks are potential damages that are influenced by human action and inaction, that is by individual and collective decision-making, in which expected benefits are weighed against negative consequences. The spectrum of possible risk situations is practically infinite, ranging from a “risky” bet when gambling to risks during medical operations to flood risks resulting from reducing costs in flood protection. Despite this variety of very different events, risks can be analyzed comparatively from a natural science-technological perspective. The central measure used is the product of the occurrence probability (calculated using fault tree analyzes or scenarios) times the extent of damage (calculated using damage potential analyses) (Plate and Merz 2001: 16 ff).

Expert-based analysis is however not alone sufficient for the design of social risk management. For one thing, even the scientific risk perspective is not perfect as it is necessarily based on incomplete knowledge, uncertain knowledge or non-knowledge (Böschen and Wehling 2004). Moreover, even expert analyses are formed by (implicit) value judgments and priority-setting. Another point is that in a modern risk society scientific analyses and the political decision-making based on them have suffered a loss of authority over the last several decades. Due to increased social knowledge, value and interest pluralism as well as negative experiences with scientific-technological “progress” (e.g., Bhopal, Chernobyl, Contergan, environmental degradation), scientific interpretations of reality do not have a monopoly position (any longer) (Heinrichs 2002: 28 ff). From a democracy-theoretical and a functional perspective, the determination and the evaluation of risks, such as the risk of extreme flooding under climate change conditions, thus include different social perspectives. As in disaster communication, it is also true for risk communication that an understanding of risk perception is basic for targeted communication activities by state actors.

Over the past 3 decades, risk research in social science has produced a great number of important findings. Psychological, sociological and cultural theory studies now offer a good basis for understanding how risks are perceived and evaluated by people and societies (Krimsky and Golding 1992; Bayrische Rück 1993; Pidgeon et al. 2003). From a psychological perspective, intensive analysis has been carried out about the extent to which risk perception and evaluation by lay populations differ from expert opinions and what the reasons for such differences might be. Psychometric risk research has discovered that for non-experts the risk formula of extent of damage times occurrence probability is not the sole criteria for their risk evaluation. Instead, they orient themselves using certain criteria that they attribute to risks. These include in particular: the disaster potential, the voluntary nature of taking on risk, the degree of familiarity with risk, the dreadfulness of an event, the distribution of benefits and risks, the extent to which one is personally affected, the credibility of those holding positions of responsibility. It is thus unsurprising that intuitive risk assessment by individuals is often at odds with scientific risk estimates. Even though, according to the statistics, the likelihood of an accident when driving a car is greater than when operating a nuclear power plant, many people will drive to an anti-nuclear power demonstration. The extent to which these characteristics are attributed to certain risks depends largely on personal attributes and environmental conditions.

There are risk averse and risk-seeking people. Emotional factors like anxiety play a role. Knowledge and personal experience influence risk perception and the willingness to act. Prior experiences generally raise the awareness of problems; though if uncertainty is high this can lead to repressing the problem and a fatalistic attitude. In addition to socio-demographic aspects, risk perception is influenced by the attitude toward nature and its dynamics, toward the political ability to act as well as toward the effectiveness of one's own actions and toward individual controllability beliefs: Women evaluate risks as a rule as greater than men and older people perceive risks to be more threatening than younger people do (summarized in Markau 2003: 129 ff). Alongside these individually variable dispositions to risk perception, perception is also guided by mental heuristics. Researchers have identified a number of central perception patterns (Kahnemann et al. 1982) which allow people to evaluate on-going situations, to make decisions and act even though risks are continually shaped by uncertainties. Risk perception is thus structured by the mental availability of (similar) risk events, the avoidance of dissonance when information contrary to existing convictions is weakened, the construction of apparent regularities for random events, as well as the habituation effect, in which regular, socially acceptable damages lead to an under-estimation of the average extent of damage. These personal determination factors of risk perception are complemented by environmental conditions. The physical proximity to a source of risk generally increases the perception of that risk. These diverse findings of psychological risk research are however unable to explain why different societies and subgroups within society evaluate risk differently and how social-cultural dynamics influence individual risk perception.

In sociological and cultural theory studies the relevance of social dynamics and cultural contexts are analyzed respectively for individual and collective risk perception and evaluation (Krimsky and Golding 1992). According to the culture-theoretical perspective, which phenomena in a society or in subgroups are interpreted as risks – or not – is dependent on basic ideas about nature as well as about forms of social organization (Douglas and Wildavsky 1983). Thus basic images of nature – benevolent, vulnerable, tolerant, incalculable – and basic types of organization – commercial, egalitarian, bureaucratic and individualistic – determine risk selection in different cultural contexts. Thus for example for corporate-oriented actors or corporation-dominated societies that have an image of nature as benevolent, many environmental risks would be considered less dramatic than for egalitarian groups of actors who hold an image of nature as vulnerable. Accordingly, this theory posits that risks are varyingly constructed and selected depending on how images of nature and social organization types are distributed in a society. This approach has been criticized because in empirical reality these ideal-typical patterns are difficult to measure (Sjöberg 1997). Nevertheless the theoretical-conceptual finding is instructive in that we should not proceed from an "objective" risk perspective, but rather that it is important to acknowledge a plurality of risk perspectives which are anchored in basic cultural patterns. Risk perception is thus not only determined by individual psychological factors and natural environmental conditions, but also and especially by social position and the respective (sub) culture. The relevance of this perspective is especially clear in intercultural comparisons, for example when one attempts to understand why in Germany acid rain and nuclear power are seen by large elements of the population as great risks, whereas in France this is not the case. Both the psychological approach and cultural theory are however unable to explain the social dynamics of risk.

Almost 2 decades ago an integrative concept for the analysis of how risk is strengthened or weakened in perception and communication processes was developed (Pidgeon et al. 2003). The ‘social amplification of risk framework’ (SARF) aims at putting different risk research perspectives together in a coherent framework in order to comprehensively understand the dynamics of how risk is processed by individuals and collective groups. Accordingly, in this framework not only a variety of information sources and channels are analyzed but also collective actors and organizations, individual perception as well as social and institutional behavior. In the ideal case the analysis of social risk dynamics would contain studies of personal communication, perception and the behavior patterns of individuals relative to a given risk as well as analyses of motivation and the activities of state, economic and civil society actors involved in risk discourse as well as ‘signal processing’ through direct and indirect channels.

A special role concerning risk perception and communication in the general populace is attributed in this context to media-structured public communication (Renn 1992). The field of mediated risk communication contains a diversity of elements and causal relationships, among which are the PR activities of political, economic and civil society actors as well as expert controversies and the “scandalization” of events. Media communication is given central importance in social risk perception and communication. We must keep in mind however that, as already noted in the section on disaster communication, information and communication processes are not linear but rather selective and interpretive (Peters and Heinrichs 2005). Risk events are ‘framed’ by journalists who use a variety of sources, each with its own information and interpretations. Individuals select and receive media services depending on pre-experiences, values, knowledge and social position and then further process the received interpretation pattern in personal conversations. Even when the importance of the media for the social dynamic of risk perception and communication should not be overestimated, because on one hand it is dependent on the risk interpretation of social actors (science, politics, business, civil society) and on the other the media reception is a (partially) active construction process by the media user, the media have, for (environmental) risks far from everyday life, an important role in social risk discourse.

Together the psychological, cultural and sociological perspectives show that risk is a construct that is created and perceived in a complex interaction between individual and collective actors in given cultural contexts and institutional structures. This basic statement holds true for risk perception in general. For risk in our case study about flooding, we can also note (Markau 2003: 167):

- Flooding is very largely seen as an anthropogenic risk.
- Flooding risks are seen as uncontrollable, voluntary and locally limited, though not as something dreadful.
- Flooding is more likely to be considered as something unlikely.

- Flooding, in comparison to other risks, is attributed a medium level of danger.
- The consequences of environmental risks, like extreme flooding, are generally underestimated when compared to technological risks.
- Experience with flooding tends to increase problem awareness, but also may also increase the habituation effect (for medium flooding) and the repression effect (for extreme flooding).
- Emotional aspects, like anxiety, are less developed for flooding than for other risks.
- The individual belief in control over a risk influences the adaptation reaction.

Since in scientific and to an extent in political discourses there is the assumption of a growing flooding risk and the need for adaptation, there is an urgent need for targeted social communication about flooding risks, protective measures and adaptation possibilities. These findings about social risk perception and communication place demanding requirements on the design of risk communication by those actors in positions of responsibility. Risk communication research has produced important findings in the past years.

The assessment of risk is largely dependent on scientific-technological expertise for analyzing damage potential, causal relationships and occurrence probabilities. Thus, it is not surprising that in communication processes between risk managers and the public the communication of risk expertise is crucial. For a long time risk communication has been conducted almost exclusively from the point of view of education and information transmission. However, in a variety of risk fields from atomic energy to genetic technology we can see that risk acceptance cannot be increased directly by providing expert knowledge (Ruhrmann and Kohring 1996). Optimizing the transmission of information was and is an important aspect of psychologically-oriented risk communication research.

Research has shown, for example, that laypeople have difficulties dealing with probability. Depending on how data is depicted, an identical probability statement can call forth different reactions (Kahnemann et al. 1982). For example in a disaster risk will be intuitively evaluated differently depending on whether one speaks of 30% dead or 70% survivors. The presentation of risk expertise must thus be carefully adapted to the communication goal. When speaking of hypothetical risks, as they are "constructed" in sensitivity analyses, we should communicate a distinction between possible and probable events.

Refined means of depicting information and goal-oriented frameworks are concerned with the information level of the communication process. The relationship level between communicator and recipient however has not yet been considered. Even highly developed information campaigns can fail to be effective or may even provoke a negative reaction if the social relationship between those participating in the communication process is disturbed. In risk communication research there have been numerous studies especially of the relevance of trust and credibility that have confirmed their importance (summarized in Ruhrmann and Kohring 1996: 38). Since trust is not something that can be possessed but must be attributed by a communication partner – or not – it must be earned over the long run by matching word and deed. The popular saying holds true here: whoever lies once won't be believed, even if he is telling the truth. Trust is then easy to lose, but much more difficult to gain.

However, even when the content is presented adequately to the communication target and the communicator has a high degree of credibility, it can still be difficult to reconcile risk conflicts. Sociological, interpretive risk research has shown that the value, interest and knowledge pluralism in highly differentiated societies, in which people live in heterogeneous socio-cultural contexts, leads to risks and risk information being interpreted very differently. The goal is thus not just to efficiently transmit risk expertise. Since risk estimates always – at least implicitly – involve values and interests, which however we cannot assume are generally shared in pluralistic societies, approaches with dialogic risk communication are important (Ruhrmann and Kohring 1996; Renn and Zwick 1997: 87 ff). In contrast to the so-called deficit model, in which in hierarchical communicative relationships the layperson is to be educated through the transmission of expert knowledge, in dialogical, discursive or analytical-deliberative models the aim is to create symmetrical communicative processes between experts and laypeople. It is characteristic for a participative and cooperative risk communication that claims to knowledge are examined in their value and interest context. Risk discourse becomes more than just the transmission of risk information; it is the understanding of risk decision-making.

If we summarize the findings of risk communication, we see that not only is a target group specific communication strategy necessary, which takes into account the plural contexts in which people in socially complex societies live, just as important is a functionally specific differentiation of risk communication. Depending on the communication goal – information transmission, creation of trust, participation in (fundamental) risk decision-making – different information, communication and participation forms are required. Alongside direct risk communication using campaigns or participative processes, which can be largely guided by the initiating actors – e.g., within the framework of state risk management activities – medial risk communication to the public is also crucial. Because of the logic of the media, especially the journalism's function as 'gatekeeper', in which journalists select topics according to typical news factors and then in a certain way frame and present them, this important information and communication channel cannot be controlled by the risk manager. Since however social risk communication is always taking place, in personal conversations and especially in the medially structured public in which a variety of risk perspectives are represented, a professional planned risk communication by state agencies using both direct and medial communication approaches is necessary.

Communication about risks, that is, about damage possibilities has without doubt points in common with communication about disasters, which is more about damage and damage recovery. Even though they are largely dealt with in separate discourses, it appears that there are, especially with a view to the phases of disaster prevention and recovery, meaningful links between risk and disaster communication. Differentiated communication about risks, for example about changed flooding risks and climate change conditions, is an important parameter for communication about disaster prevention needs and measures. Moreover, in the disaster recovery phase risk communication can help make risk decision-making explicit in order to reach an understanding with the population about what safety to what price should be achieved, how risks should be distributed and how responsibility in disaster and risk management can be divided between state and civil actors. Disaster and risk communication focuses especially on the negative effects of specific biophysical events, for example flooding, on the calculability of uncertainty (occurrence probability × extent of damage), on the perception and the behavior of individuals and groups and tends to follow a short to medium term perspective (Gray and Wiedemann 1999). When however due to changed parameters – e.g., climate change or land use – more basic transformation and adaptation processes appear necessary (see LAWA 1995, 2001), then disaster and risk communication reaches its limits. In the context of the discussion about sustainable development, disasters and risks as non-sustainable dynamics are a starting point for a medium to long term perspective, in which positive creative alternatives are in the foreground, phenomena are to be integratively processed and so address not only individuals and groups but also society-environment systems (Gray and Wiedemann 1999: 204). Recently new approaches to a sustainability communication have been developed.

Sustainability Communication

Twenty years after the much cited Brundtland Report and 15 years after the Rio Conference for the Environment and Development, during which Agenda 21, a model of sustainable development, was ratified by 183 nations, a great variety of sustainability activities on international, national and local levels have begun.

There is a great richness of scientific analysis, modeling and simulations, which record non-sustainable development trends, such as for example global climate change, biodiversity loss, or soil degradation. There are political activities, for example the adoption of international conventions, the setting up of sustainability councils and the development of sustainability strategies for different political levels of action.

Civil society groups and NGOs, especially from the areas of environment and development but also new initiatives for generational justice, are taking up this topic. Corporate enterprises are setting up sustainability departments, publishing sustainability reports and businesses are founding sustainability-oriented lobby associations such as the World Business Council for SD.

As part of the UNESCO decade “Education for a sustainable development”, which began in 2007, the topic is being propagated in the educational field. In the science landscape an active scene of sustainability research at an international level has come into being.

The mass media reports intensively about (partial) problems of sustainable development, for example global climate change. In addition, the topic is taken up in documentary films (Al Gore's "An Inconvenient Truth") and in fictional formats (Roland Emmerichs's "The Day After Tomorrow"). And in the new media Internet there is an endless variety of information from scientific institutions, political and civil society actors as well as interactive communication channels, e.g., weblogs, which are or can be used by interested individuals. In the general populace (in this case Germany) the majority shares the central ideas of sustainable development and so there is a basic societal resonance (Michelsen 2005: 25 ff).

The topic sustainability is now without doubt a part of social reality. But although there may be an increasingly accepted awareness of the problem which recognizes that there are current social and biophysical dynamics – driven by globalization and global climate change – which trigger risky disruptions to society and the environment, there is a great degree of openness concerning the interpretation of what form sustainable development should take. Since it is no less than a co-optimization of social, ecological and economic development, in which temporally and spatially distanced effects (inter- and intragenerational) are taken into account, we are dealing with uncertainties in knowledge (cognitive level) and ambiguities in evaluation (normative level). Alongside necessary legal and market economic approaches, communicative approaches are crucial in order to initiate understanding-oriented opinion, intention, decision-making and design processes (Heinrichs 2005b).

As a topic and research field in "status nascendi," sustainability communication has however hardly been theoretically developed and empirically applied. It links approaches to environment, risk and science communication and has an interdisciplinary orientation (Adomßent and Godemann 2005: 42 ff). Sociological, psychological, communication and education perspectives are used in order to analyze and, if necessary, optimize communicative aspects of sustainability in a number of activity fields, e.g., media reporting and 'new' media, education for sustainable development, PR and social marketing, corporate communication, political communication, participation and cooperation, exhibitions (Michelsen and Godemann 2005). Different levels of action (local, regional, national and international) and problem areas such as nature conservation, mobility, energy, consumption etc. emerge as part of the problematic. In addition to the information-oriented popularization of the model of sustainable development, it is a special challenge for sustainability communication to enable understanding-oriented communication. This is indispensable especially considering the complex individual but also the collective decision-making and design processes regarding sustainable development, in which it is also about conflicts with often uncertain, anticipative knowledge claims as in discussions about possibly necessary adaptations in priorities of value orientations and preferences. Because sustainable development processes are open to interpretation and design, dialogic, participative and cooperative approaches are especially relevant. An increase in individual participation, as for example in the many local Agenda 21 processes which were initiated especially in the 90s, is just as much a part as cooperative processes for systematically involving entitled groups in decision-making processes such as mediation, citizen reports, consensus conferences (cf. Heinrichs 2005b).

In the current discussions about sustainability communication, it is conspicuous that the topic adaptation has been given little or no attention. The normative and the analytic focus are clearly on the aspect of avoiding or reducing non-sustainable social, economic and ecological processes. In connection with the challenges of climate change just described, this priority of avoidance before rehabilitation before adaptation, which comes from the welcome tradition of environmental policy, is however inadequate. The knowledge and development potential that the still young area of sustainability communication has made for itself is an important contribution for our concept of adaptation communication. We can use the topic of climate change and flooding, which is a with a problem constellation defined by high technical and social complexity, to illustrate the importance of sustainability communication for adaptation communication.

Global climate change, in addition to the straightening and deepening of river beds, affects the flooding situation through raising the sea level and increasing storm flooding risk in river estuaries (as in our case Hamburg and Bremen) as well as glacial melting and changed patterns of precipitation. Intensified land and spatial use – driven by social and economic trends – increase the potential for damage near rivers.

Numerous actors with different interests, values and knowledge claims must be accounted for in complex multi-level, multi-stakeholder processes (flood protection, inland shipping, agriculture, tourism, construction, individuals etc.).

Communication about a sustainable development in regard to flooding as a local and regional event thus goes beyond approaches to disaster and risk communication. It is not just about information and communication to optimize disaster and risk management, it is more a medium to long-term oriented transformation of the interaction between environment and society, which is more future-oriented, that is more ‘sustainable’, than current structures. Disaster and risk communication need in this sense to be completed by a future-oriented sustainability communication.

Adaptation Communication

In order to reduce potential damage sustainably and to ensure an appropriate behavior in the public in case of a disaster, a differentiated public communication about disasters, risks and sustainable adaptation possibilities between responsible (state) actors and individuals is necessary. Specifically needed is a proactive initiation of a social discourse by responsible institutions about distributing responsibility and possibilities to act in case of a disaster, about a rational analysis and evaluation of risks, which takes up the plural social claims as well as cooperative strategies of sustainable development. Approaches from disaster, risk and sustainability communication are relevant here, all of which can be integrated in a concept of adaptation communication.

At first it is about a comprehensive disaster (prevention) communication that is to prepare the population should there be a flooding event and in that case to have individuals as competent partners of the professional disaster protection actors. This includes both information as to behavior in an emergency and in the aftermath as well as to possibilities for individual and collective self-protection in order to support the cooperation between the population and professional actors in case of a disaster.

Risk communication is furthermore necessary in order to achieve a systematic understanding process between state institutions and individuals about risk, residual risks and the necessity to act to reduce and manage risks. On the one hand it is about increasing the awareness of flooding risks in the population based on natural science-technological risk analysis. On the other it is about the social-political evaluation of risks and options to act in taking account of individual's risk perceptions. Communication about current and future flooding risks under climate change conditions requires information strategies and dialog-oriented communication and participatory opportunities.

Finally in sustainability communication, a term which has appeared infrequently in scientific and political discourse about flooding management, communication about risks and the management of risks is not the end but the starting point. It is about initiating searching, learning and management processes, which anticipate temporal-spatial distanced effects, which are not confined to one sector and instead integrate flooding with other areas such as ecological carrying capacity, population and economic development and intra- and intergenerational social justice. Sustainability communication thus follows a broader systemic-transformative perspective than risk communication, which is more management oriented and more oriented toward individuals and groups. The participation of claimant groups and individuals in communication and decision-making processes for sustainable development in the topic area of flooding is crucial.

The integrative framework of adaptation communication may contribute on the one hand to a better understanding of societal perception and communication processes of disaster, risk and sustainable development related to global environmental change. On the other hand it provides a conceptual basis for a goal-oriented improvement of communication praxis to support anticipatory adaptation efforts.

Adaptation Communication: New Perspective for Science and Practice

The proposed theoretical-conceptual framework of adaptation communication opens up new perspectives for scientific analysis and socio-political praxis. With regard to empirical research, the framework provides a conceptual basis for the systematic and integrative analysis of the intertwined societal communication on disasters, risks and sustainable development, which is mostly separated analytically in different schools of thought and research. And the change-oriented focus on adaptation strengthens the potential of this approach to open up new research questions even more. The analysis of institutional-administrative and "mediatized" public communication, of the perceptions and awareness of citizens and stakeholders and of participatory and of cooperative decision-making in the context of adaptation is a challenging field of research. We developed and applied this approach within the field of climate change, flood risk and coastal protection in Germany and with a special focus on communication processes between administrative communication activities, mediatized public communication and citizens' perceptions and awareness. It will be interesting to test and develop further this framework. First, for different fields of adaptation such as desertification, extreme weather events such as heat waves, the consequences of changing weather patterns in different sectors such as agriculture, urban infrastructure, tourism and alike. Second, comparative analysis of case studies in different world regions is needed to test the general validity of the integrative framework for researching communication on adaptation. Third, the interesting topic of science-policy-communication and communication within the political-administrative system, which is only marginally included in the proposed approach, deserves further conceptual development.

Next to its scientific relevance, the concept aims at providing policy-makers and professionals with a tool to better understand and optimize their communicative activities in the field of adaptation. When social-political goals dealing with the local and regional consequences of global environmental change are to have disaster and risk competent citizens as partners of adaptation management and not only as an audience, then a professional, communicative and cooperative approach to politics is crucial. This would increase the chances of achieving an educated acceptance of disaster protection measures and a stable legitimation of risk management decisions, as well as activating the competences of citizens and mobilizing their potential to shape adaptation strategies within a framework of sustainable development. The approach of adaptation communication would make a contribution to this project.

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Part V
Coda Chapter

Chapter 19
Moving Ahead: Environmental Sociology's Contribution to Inter- and Transdisciplinary Research

Matthias Gross and Harald Heinrichs

This volume's goal is to further scholarship within the intellectual tradition of environmental sociology and its inter- and transdisciplinary connections. That it is time for sociology to generally move away from its purely internal debates has been pointed out by many sociologists in the last 4 decades, who have lamented the low impetus of sociology in public forums and policy issues and have uttered a general crisis of the discipline (see e.g., Gouldner 1970; Lemert 1995; Lopreato and Crippens 2001; Clawson et al. 2007). It is our contention that many of these critical assessments of the current state of sociology are also a crisis of sociology's potential for trans- or at least interdisciplinary collaboration. And indeed, it appears to be unclear as to what extend sociology is able to deliver relevant knowledge to the solution of pressing societal questions in cooperation with other disciplines. The editors of this volume believe that environmental sociology, unlike many other sociological subdisciplines, has taken up the challenge of interdisciplinarity since quite a while. In Europe, the term transdisciplinarity is most often used to describe integrative forms of research that comprise different methods for relating scientific knowledge and extra-scientific practice in problem-solving. In this way, the research topics of many streams of European environmental sociology are not mainly driven by self-referential disciplinary theory building, but they are inherently problem and solution-oriented and therefore necessarily inter- and also transdisciplinary.

From a traditional sociological perspective it is, of course, always possible and sometimes highly important to maintain a distant observer position in the analysis

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of environmental problems. Paradoxically, however, it has also been sociologists who have made the claim that research in the twenty-first century is generally on its way to a more transdisciplinary form of applied science and networking (Nowotny et al. 2001). However, sociology itself so far is not interested much in bringing its own research results to the table of transdisciplinarity. Such a change in perspective is a challenge for sociology (as it is for any discipline involved, especially some of the social sciences and humanities), but we contend that in the twenty-first century sociology needs to open even more to inter- and transdisciplinary collaboration, in order to develop its own disciplinary perspective and raise its relevance for social practice. This volume thus should be understood as a screening of some of the direct disciplinary neighbors of sociological scholarship that appear to be good partners and collaborators on our path of entering the knowledge society.

In assembling this volume over the years, we identified four main areas of research that take up the challenge of environmental sociology in an interdisciplinary and increasingly problem and solution oriented world of research. The first one, which we labeled "Natural Flows and Global Environmental Discourse," points to the interdisciplinary connections of environmental sociology as regards the inclusion and connection to variables non-social, that is, the material world environing human groups and societies. Current research we present in this book points to the often unexplored classical sociological possibilities but also the limitations to include things non-social into the world of sociology (Arthur Mol; Bianca Baerlocher and Paul Burger). These issues are spurred by new discussions on global climate change and the reform and governance processes involved solving problems related to these issues (Fritz Reusswig and Frank Biermann). Regarding the challenges of global environmental change (environmental) sociology needs to free itself even more as it has done over the past years from nationally bounded perspectives. Based on these contemporary discussions but also departing from them, our next major theme of the book focused on the "Limits and New Possibilities for Understanding Environmental Rationalities." Steven Yearley discussed the ways in which space is given to social and environmental aspects of the new life-science industries within European regulatory systems. He examined how these social and environmental aspects are rationalized and yet at the same time are limited and restricted. There is an apparent paradox around these regulatory considerations, which around create a space and a need for interdisciplinary analysis. At the same time a time-honored problem arises. The technical disciplines tend to specify in advance and to specify in restricted ways the kinds of job that others get to do. Whereas some ethicists' work is encouraged, empirical social scientists work tends to be overlooked.

One field where environmental sociology has been rather slow and perhaps thus overlooked has been the usage of modeling and social simulation. In order to explore the potential of this type of interdisciplinary environmental sociology (which is still in its infancy, at least as an explicit part of environmental sociology), we invited an article on agent-based modeling of the diffusion of environmental innovations (Andreas Ernst). However, as fruitful as modeling in the social sciences can be in terms of sorting out key drives of social dynamics and envisioning potential (future) developments, we all know that the social is always more than can be grasped in even highly sophisticated computer models. Issues such as trust for successful governance processes (Stefan Walter), the often wrongly perceived ideas of Rational Choice Theory (Ulf Liebe and Peter Preisendörfer), as well as the limits of knowledge in democratic environmental decision-making in general (Luigi Pellizzoni) point to the many interdisciplinary connections that environmental sociology touches on. However, these connections need to become even tighter in the future in order to be able to deliver knowledge for the solution of real world problems. This issue also points to a challenge that goes beyond interdisciplinary collaborations. It links to the general thesis that contemporary research – and environmental research in particular – is increasingly carried out in the real world, that is, the research context is set by a process of communication between various stakeholders and not by internal scientific issues (Nowotny et al. 2001). Many observers have thus hypothesized that contemporary research is increasing its potential to joint problem solving among science, technology, and society, to allude to the subtitle of the well-known book by Klein et al. (2001). Consequently, our next theme in the book focused on transdisciplinary collaborations in the context of sustainable development. Of first order importance here have been sociological research projects, often in cooperation with political scientists, economists, and geographers, to analyze different types of knowledge and possibilities of social learning (Bernd Siebenhüner and Harald Heinrichs). By explicitly taking up the challenge of "transdisciplinarity" in environmental research, our book has also included a discussion on the potential to learn from case studies as a means to foster sustainable development (Michael Stauffacher) and to explore possibilities and limits of new conceptual approaches such as "practice theory" (Karl-Werner Brand), which so far have not been discussed much in environmental sociology. Furthermore, recent ideas on a "mobile turn" in environmental sociology (Henrike Rau) also coincide with debates on the growing interconnectedness in a globalized world. All these approaches have in common that they go beyond disciplinary mindsets taking themes and concepts from respective "other" disciplines to sharpen our understanding of developing practical solutions to sustainable development for societies in the twenty-first century. Our final theme connects to the challenge of environmental sustainability by focusing on "Adaptation Policies and Social Experimentation." Environmental sustainability has also been a challenge for new types of communication via modern media (Heinz Bonfadelli) backed up by recently spurred debates on adaptation strategies to climate change (Harald Heinrichs). In order to come to terms with the challenge of adaptation to changing natural or human induced environmental conditions, some authors have gone back to classical pragmatist ideas from North American sociology to frame new forms of democratic social experimentation in niche situations (Christine Overdevest, Alena Bleicher, and Matthias Gross). These types of community experiments explore problem framings and search for socially acceptable solutions.

However, experiments outside the laboratory bring new risks and uncertainties and, in turn, call for new types of environmental policy and governance (Piet Sellke and Ortwin Renn). All of these articles in this thematic block have tackled the transdisciplinary challenge of environmental sociology where the institutional borders between the production, communication, and application of knowledge have become blurred – or at least have developed into a tighter coupling of these various elements, which has consequences for all. After all, one major theme throughout our book's chapters has been to argue for enhanced interdisciplinarity in making ethical and environmental assessments.

We hope our volume was able to show that environmental sociology has contributed fruitfully to these thematic fields of inquiry (there are many others, of course), but also that there is no doubt that environmental sociology still has a long way to go to fulfill its potential to playing an important part in interdisciplinary collaboration and real world problem solving. Furthermore, environmental sociology must not loose sight to serving its mother discipline, that is, to feed back the nuggets reaped from its inter- and transdisciplinary journeys to develop further sociological theory and methods. Overall and in face of new interdisciplinary collaboration programs on a European level, discussions on sustainability research that can only be undertaken via transdisciplinary networks, not to mention the increase of problem and solution oriented research and development programs on different national levels, we cannot help but notice that environmental sociology – despite its minor status as part of its mother discipline and its many shortcomings otherwise – has done something right. This is even more so, since at any major sociology conference, where a sociologist introduces anything that is not rendered purely social but possibly material or otherwise non-social, the argument is brought to the fore that this would be un-sociological – instead of asking if that variable helps to better understand certain social phenomena. Perhaps this is because sociologists fear that things non-social in the equation might harm sociology? We doubt that this is the case. After all, even Georg Simmel, who is not generally known for his attempts at making sociology a practice-oriented discipline, summed up his well-known article "The Problem of Sociology" by writing that "the real question is to state problems and to solve them and not at all to discuss the names which we should give particular groups of them" (Simmel 1895: 420). The example of environmental sociology shows that interdisciplinary collaboration including the "sociologizing" of areas that were formerly rendered un- or a-sociological (economic, political scientist or different parts of environmental studies and ecology) does indeed not harm sociology, but in the long run appears to strengthen sociology and feeds back important concepts into the general discipline.

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