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Contradictory Approaches? – On Realism and Constructivism in the Social Sciences Research on Risk, Technology and the Environment

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SOCIETY, ENDANGERMENT, PERCEPTION, EPISTEMOLOGY, ONTOLOGY

Abstract

This article discusses approaches to researching the risk-problems of industrial societies. It examines why the risk-*constructivism* neglects questions of the material production of risks in favor of questions of their communicative construction, while the risk-*realism* does it the other way round. Subsequently the possibilities of a synthesis of both approaches are being considered. The societal functions of risk-constructions are accordingly not limited to their efficacy in the sphere of social *communication* processes. They lie as well in the field of regulation of the *metabolism* of societies and their ecological environment. The validity of risk-constructions is consequently not only bound to their cultural weightiness, whether one believes in them or not, but to their capacity to manage realities, measured by their ability to bring expectations in accordance with events. Risk-constructions are not only transformed in the milieu of *discourses*, but also in the context of social *practices* which give the opportunity to acquire experiences and to perform learning processes in order to optimize risk-constructions as regulative instruments.

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1. Prologue: Questioning Propositions and Approaches

Are phenomena like the hole in the ozone layer or asbestos poisoning, global warming or electro-magnetic radiation, real dangers? Or are they nothing else than phantom menaces? Do they exist as parts of the physical world? Or are they only questionable constructions of the media? Each attempt to give serious answers to these questions has to take into account the complex of epistemology, ontology and methodology that determines any elaboration of scientific truth [1]. For sure, this is valid also for the social sciences, that are working generally – and in particular on environmental and technological risks – in the area of methodological tensions between *realism* and *constructivism* [2,3,4,5,6]. The first approach analyses them in the context of the intensification and extensiveness of nature's manipulation and utilization. The second is focusing on cultural changes in the societal perception and processing of uncertainties. Do both approaches exclude each other? Or are there possibilities for a synthesis? Anyway, in order to settle recent struggles there is need to examine profile and function of these approaches.

2. Introduction: Conflicts about the (Un-) Reality of Risks

In so far as risks are associated with damages (being avoided) as well as with attempts to realize benefits they are necessarily related to particular interests that converge or diverge according to the stakes of the focal actors. As a discursive expression of this structure we can – together with Duclos (in his "Le Monde diplomatique"-article about "Effets nocifs des discours sur les dangers" [7]) – observe a characteristic pattern: "Certes, les discours se contredisent. Des puissances antagonistes minimisent le risque de leurs activités en majorant celui des autres: les partisans du nucléaire dénoncent les accidents de la route, mais insistent sur la vertu nucléaire face á l'effet de serre, ce que contestent les pétroliers".

Against this background we can recognize that each (proposition that entails a) *judgment about risks* is a relative one, especially in its role as an element of the quarrel about the question which risks are more important than others as problems that need to be encountered by the society as a whole. None of them is true in an absolute sense and all of them are true in a relative sense, relative to other risks and relative to their evaluators. Some comparisons seem to be nonsense (or simply: manipulative) – the risk of nicotine abuse versus that of radioactivity from atomic power plants for example. But the quarrel about the priority of risks is principally useful, because its

purpose is to use our resources in such a way, that damages are as much as possible being prevented while gaining the greatest benefit.

In this context obviously the question emerges: "What is, indeed, *our* benefit?" And how to assess those damages, by which some parties (individuals, groups, organizations) are more affected than others? And how to evaluate them when they interfere disparately either with our physical health *or* our economical welfare – either with our mental sensibility *or* our environmental quality?

Interwoven into these questions is another issue which can be separated analytically, however. It is the question about the authenticity of risks. It expresses itself when we pose questions like: "Is asbestos in school buildings *really* dangerous?" or "Are electro-magnetic emissions *indeed* jeopardizing people using their mobile-phones?" or "Does there *in fact* exist some hole in the ozone layer?" or "Are we *actually* experiencing a world-wide greenhouse effect?".

Moreover, doubt can be directed towards all known elements: whether a phenomenon is really able to cause considerable harm or damage or not; whether its occurrence is considerable probable or not; whether there are – or are not – possibilities to avoid or to compensate for it; etc.

Starting from doubts about the genuineness of single threats each particular question can lead to the general question whether an "ecological crisis" truly exists, that is, whether the propositions of an "ecological crisis" of the society and the entire debate about this theme could be reasonably justified. At least a publication entitled "But is it true?" from Wildavsky [8] has to be understood exactly in this sense. Arguing expressively in this direction is, among others, Bailey [9] as editor of an anthology called "Global Warming and Other Eco Myths" and Lomborg [10] whose statistical monograph is published under the title "The Skeptical Environmentalist – Measuring the Real State of the World"[1].

Isn't it a fact, that the "end of the pipe"-policy has been quite successful? Didn't the air and the water become remarkably cleaner? Isn't it consequently time for the all clear signal? It seems easy to agree with authors like Maxeiner and Miersch [11] when they are pointing out, that

[1] With Fuller [97] we can get an impression of the public frontlines of the controversy ("Support and opposition for the 'Sceptical Environmentalist' are divided along predictable lines, with, say, 'The Economist' championing Lomborg and the 'Scientific American' condemning him") as well as of the inner-scientific contest about "the larger question of who is authorized to define the field of environmental science", or, more to the point, who has

"doomsday"-scenarios have increased the mobilization-rate and the protest-capacities of the environmentalist's movement enormously, and – on the other hand – that constructive, environmental policies are in need of a good portion of "Environmental Optimism" (so the English translation of their title). But tactical considerations and debates about collective attitudes cannot substitute environmental research and its analysis of the development of the actual environmental situation, even if they take into account the function of looped sequences like self-destroying or -fulfilling prophecies that may release ameliorative effects.

Obviously rather more research is necessary – in order to be able to clarify these or other public doubts, but above all because it is favorable to be well-informed about the width and depth of the problems we are faced with. That has of course its boundaries. For instance there, where in the face of the highly complex processes of "emerging systemic risks" [12] the limited prognostic capabilities of the sciences are being used in a politically motivated way, as if simple "if/then"-statements were possible, or, to be more exact: could be scientifically justified in order to provide legitimation for political decisions.[2]

Doubts, including those which emerge from other reasons or interests, cannot even be encountered by an elaborated (natural) science which is doing meanwhile precisely that, what critics have demanded for a long time, namely to "leave" the laboratories and start researching high complex "real-world problems" or developing not less complex innovation strategies, instead of doing their work of R&D under reduced, artificial, and experimental circumstances.[3]

Anyway, we have to concede that climate-prognoses are in principle – like all other forecasts – uncertain! They cannot be as certain as the "Amen" in church. But it would be wrong to measure the "science of the complex" and its analytical power, that is developing i.e. in climate-research, by the standards of Newton – and his understanding of science conforming to the mechanistic world-view [13].

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the right – or the epistemological supremacy – to interprete the statistical data of the broad cross-disciplinary field of GEC: only natural sciences and engineering or also economics and social sciences?

[2] If it is true, that "the world in the past was less complex, less interconnected, and more forgiving of mistakes and miscalculations" because of the growing density of interactions between a multitude of differentiated systems then we should recognize that the proposition of Rejeski ([75], p. 48), that "many of the phenomena that policymakers face no longer change in simple, predictable ways" is today more relevant than ever.

[3] This progressive practice does not need only interdisciplinary cooperation but also the permit to enter areas of increasing scientific uncertainty, regardless of simultaneously emerging problems (especially with regard to its evaluation or the chances for consensus) that are the price to pay for this kind of indispensable research [98,99].

Answering questions about "What is true?" (or: "What is false?") is not just important in an academic sense. Acknowledging something as true or false has consequences beyond the domain of epistemology, namely in the social dimension. Seeking to convince all others in order to establish the dominating "reality" or "truth" (or better: "putative reality" or "propositional truth") of the society is therefore nothing less than usual business concerning the public agenda. Its cycle of common alertness, that attracts or distracts the (especially in 'information-rich' societies very) 'scarce resource' attention [14] to or from the issues in question, correlates with electing preferential socio-political goals, elaborating priorities for socio-economic strategies and distinguishing paths of scientific-technological development [15,16].

Especially "GEC", the issue of the world climate-related "Global Environmental Change", has turned into a controversial topic of this kind up from the mid 90ies. Bailey (1995 [17] – as well as 2002 [9]) for example sees the "True State of the Planet" considerably less threatening, as the World Watch Institute (1996 [18]; as well as following publications out of this source), the German Advisory Council on Global Change (1996 [19]; as well as following publications) or the Intergovernmental Panel on Climatic Change (1996 [20] ; as well as following publications) are doing, with such an amount of success that Tonn [21] declares the thereby praised IPCC a "global scale transformative initiative" while others dispraise its policy of consensual, negotiated and goal-oriented statements as scientifically questionable.

It becomes quite obvious that this kind of debate, about the "environmental question" of the late industrial society, is neither new nor uncommon, when looking at a simplifying historical parallel concerning the "social question" of the emergent industrial society [22]. There were arguments about its status:

- Whether the "social question" is a fundamental, "objective" problem of modern society, that has become part of the socio-industrial reality right from the beginning, as one of the consequences of capitalism (of its unequal – and implicit: unjust – pattern of distribution of the produced wealth).
- Or whether it is an "invention", fabricated by the labor movement, in order to receive a strategic pretext for whom or what to blame for, styling incoherent "naturally" caused (or "individually" provoked) phenomena like poverty, that no one (or no one besides the victims)

could be blamed for, into consequences of industrial capitalism (that finally could be blamed for all the evil).

Together with Lau [23] we can recognize here, that already the definition of risks (followed by their management) has become a major subject in the arena of social conflicts. Risk-discourses are being performed which are a new type of social *interest*-conflict in so far, as they catalyze the distribution of risk-costs and -benefits. Beck's [24] thesis of a leveling of affectedness in front of the de-limited consequences of modern catastrophes should be corrected therefore. Even the example of global environmental changes presents another image. The *insight*, that humankind is affected as a whole, doesn't automatically establish a common (and uniform) horizon in the sense of one "World Risk Society" [25]. Yet conflicting interests about who has to react (e.g. to stop his excessive emission of greenhouse gases) or needs not to act (e.g. by the non-ratification of climate conventions) are gaining momentum, also in so far as divergent ways of doing so and distinctive amounts of expenditure are disputed in this situation [26]. On this background it is not astonishing – at least not for an observer trained in epistemology – that the theory-dependence and the therewith associated hypothetical character of stuff like GEC has obtained a prominent role in midst of the ongoing debate about the "risk landscape of late modernity" [27].

With regard to this circle of issues some scientists have done some valiant and valuable explorations, but there remains – in terms of theory – some unsatisfactory state, because of missing sufficiently differentiated models that are able to cover all relevant aspects of the theme while integrating the necessary explanations. On one side or other of this debate …, there exists more than enough scientific power to develop arguments in order to criticize others, but less than enough power to back-up the own position while evaluating some phenomena as overblown and others as underestimated [28].

- Glassner [29], for instance, has elaborated (under the title "The Culture of Fear – Why Americans are Afraid of the Wrong Things") a series of excellent analysis regarding phantom dangers (as e.g. "killer kids") and overblown risks (as e.g. "plane wracks"). But his thesis – that the selection of fears are standing in some particular relationship to the dominant cultural beliefs and biases (according to the theories of M. Douglas') – could be redirected, without any distortion, to himself and his selection of phenomena that should be counted as "real problems", respectively as solely "imagined ones", as for instance "poverty" and

"drugs" – that for sure mean a lot, respectively nothing unusual, to a liberal sociologist of this generation.

- Another aspect of the same problem was analyzed by Easterbrook [30], who has – in his book about "The Progress Paradox – How Life Gets Better While People Feel Worse" – worked out the thesis that there exists a contradiction between the quality of life in terms of its objective indices and of its subjective perception that seems to be characteristic for our modern civilization. But his division of "the feelings of the people" on one side of the coin and "the ciphered facts of life" on the other side is too schematic and neglects the problem, that even the selection of some ciphers and facts, while neglecting other ciphers and facts, is contingent (may be arbitrary), and could itself not be done in an objective manner, because to select criteria is essentially a subjective value-judgment. From that results: there might be other ciphers and facts that are offering more than enough reason for the people to be frightened, although those ciphers and facts selected by Easterbrook seem to prove his suggestion that there is a hiatus between the inadequate and unreasonable feelings and perceptions of the population and the facts about life.

3. The Ambivalence of Risk – A Paradox not Solvable?

It doesn't matter if the sciences, the jurisdiction or the whole society is concerned, the fact is: "To err is human". Guilty parties are acquitted and innocent ones are condemned. Wrong hypotheses are taught and right ones are controverted. The society can agree upon ignoring real threats while attending to delusory dangers. Each decision could have (and regularly has) positive as well as negative consequences, and is therefore in itself a risk factor. Rapoport [31]– in his famous work about normative and descriptive approaches to "Decision Theory and Decision Behaviour" – speaks therefore about the emerging "ambiguity of risks"; confronted with this there is no other way than to decide under conditions of (more or less) uncertainty.

Decision-making processes need to be sensitive to truth-claims. But there are at least – with reference to the distinction of explicit and implicit propositional types [32] – two ways to examine a statement. Frequently we hear: "I believe only that, what I can see!" or "I repeat only, what I have heard!". Both are points of view of daily life, referring, however, to something fundamental: Statements concerning environmental, technological or medical risks can be revised in different ways.

- One way is to assess their validity related to the complexity of the *bio-physical world*, related to our knowledge about technological, ecological or physiological interdependencies.
- The other way is to judge them by setting them into the context of their *socio-cultural* complexity and to ask to whom they are of avail or of disadvantage ("cui bono?"), how trustworthy their originators are, and whether they are complying with generally recognized convictions or not.

In order to illustrate both ways of reasoning, here some prototypical phrases: "It is true that asbestos is a hazardous substance, because experiments on animals have shown ..." or "That's not true! The critics of this useful substance (protecting people against excessive heat) just want to discredit the industry". "The holes in the ozone layer and the greenhouse effect are established facts, verified by the following measurements ..." or "They do not exist, they are merely a fiction created by environmental researchers and movements with mutual self-centered interests".

The last mentioned statement, for example, can quickly lead us to the – rash – conclusion, that the global environmental and climatic changes are nothing but a construct of societal communication, blown up out of proportion by media events like Al Gores "Inconvenient Truth" [33], setting a good example of how society can construct a "problem" – or in the worst case a "State of Fear" (Crichton [34]) –, which perhaps in reality doesn't even exist or which dimensions are quite uncertain (cf., e.g., [35,36.37,38,39]).

Now, how shall we – as social scientists – decide what is indeed the case? After all there are not only groups, which make us think that the perils posed by global environmental changes are exaggerated, but there are also those factions, which have a tendency to play them down.[4] The ideology-critical discourse – concentrating on (differing and not seldom opposing) interests that may be related to (distinct) truth-claims of propositional knowledge – must remain of limited usefulness here, at least as long as the social sciences are not able to back up their findings independently with those of the natural sciences research [40], optionally including atmospheric physics, environmental chemistry or climatology. Otherwise nothing remains but – the methodically very questionable – statement that these arguments are nothing more than

[4] Here we just need to look at the example of the "industrialized countries", which are as a main originator of the climatic changes, as well the main beneficiary of a prosperity, which is being produced with 2/3 of the global consume of fossil fuels, while the "developing countries" are the most affected by the predicted shift of eco-zones.

(contradictory) social constructions, in principle beyond any possibility of verification (or not less: falsification).

4. About the Relationship of Problems and Problematization

Veritable social conflicts about uncertainty-limits, evidences, and risk problems arise when the statements in question are settling issues of far reaching consequences like for example determining keys for the distribution of goods and obligations (imagine for instance the introduction of new limiting values for radiation during mobile-phoning or for the allowed dosis of organic compounds in drinking water).

Conflicts of this type, however, can sharpen our understanding about issues like: "Is the world-wide soil erosion more alarming than global climatic changes?". Whilst discussing issues in this way we can check, whether the public attention is adequately directed towards the most urgent problems. This is not at all an academic procedure. Since the public (and with them the scientific) discourses are directing the political distribution of means for risk-management; since they create models of intended technological progress and determine society's socio-economic strategies, they constitute a power which is influencing and reforming societal as well as environmental realities.

False priority setting – or even worse: fear-driven attention to illusionary dangers – causes a waste of public resources without any, or, little ameliorative effects. Simultaneously these resources are taken away from trying to solve other, more serious, problems.

The following question (representing the central theme of "Risk and Culture") posed by Douglas and Wildavsky ([41], p. 1) may serve us as a guideline for developing this field: "Are dangers really increasing, or are we more afraid?". In order to tackle the logical structure of this matter we can refer to a plain survey published by (the German popular magazine) Geo-Wissen [42], because it illustrates the quintessence of this issue. The question: "Is our life more risky today than 20-30 years ago?" was answered with a "Yes" by 57% of the interviewed persons. This could mean – simplified:

- Life has actually become more risky, and the results of the survey are mirroring these changes.

- Life has objectively stayed as risky as 20-30 years ago, but the interviewed persons are assessing the present-day risks higher than those of former times because they have become more sensitive towards them.

Correspondingly, in order to explain the development of a strong environmental movement, one could – focusing on the ideal type characteristics of the given arguments – say in a polarized manner that:

- Either: The increasing environmental problems and augmenting risks of the technological progress have alarmed the public and have led to a mobilization of critical forces.
- Or: The appearance of the environmental movement is the result of shifting values and cultural change and has nothing to do with increasing risks.

When analyzing the different ways to verify these contrary propositions it becomes obvious that the decisive question *whether* the risks have been really increasing *or* we have become more sensitive about them, cannot be answered by surveys (investigating self-declared attitudes).

The interpretation of survey results needs corresponding background assumptions (serving as context); either implicitly presumed or explicated ones. In the first case methodologically uncontrolled outcomes are to be expected. In the second case emerges the problem that explicated assumptions have to be accounted for. It can, of course, be mastered as far as this can be done by using knowledge generated by the social and economic sciences themselves – for instances about the development of the level of material wealth that is of crucial importance here. But another situation arises insofar as there is need to transcendent this knowledge-base because accounting for this assumptions is not possible, however, without recourse to those findings, which were elaborated outside of the focal surveying discipline "social sciences" (and its methodological prescriptions) i.e. in the form of an aggregation of environmental indicators or the documentation of reference-ciphers of health threatening perils [43]. Within the framework of sociological investigations this causes of course problems. It might be worthwhile though, to work upon this problematic issue, because it is a tricky matter to dissociate sociological research from other sciences and to base crucial keys of interpretation on mere opinion, the common sense of the mass media, or on the ideologies of institutional elites or social movements. It does not matter if one personally favors one position or the other; assumptions of this kind remain in any case – at least as far as science is concerned – unsatisfactory.

5. Considering the Constructivist Approach

The constructivist approach comprehends "risks" as constructs of societal communication and explains "the increase of environmental and technological risks" through cultural processes of change. Douglas and Wildavsky [41] – two important representatives of constructivism within the field of risk research[5], who are selected here in order to give an example for its specific pattern of argumentation and its implications – state, that the balance of power between the central cultural institutions (including the market and the hierarchy) and the sect as the socially peripheral subculture, has shifted so eminently, that the risk-aversions of social movements (which are said to perform "egalitarian" ways of life) have turned into a prevalent subject and thereby predominant "reality" for the developed industrial societies.[6]

Environmental criticism is – according to these premises – (mis-) understood as (in any case) anti-industrial and anti-modernistic, originating from attitudes against the establishment, opposing capitalism etc., while the factual content of its argumentation – together with the possibility of truly existing causes for its concern, regarding environmental degradation or negative effects of technological progress – is neglected.[7]

While focusing on established values and institutional stability as a guarantor of social order, they take up the prevalent point of reference of the American structural functionalism – however, no longer under the premises of the analysis of "equilibrium", but referring to the "resilience" of institutions. Here not the ecological problems appear as a threat to "society" (whereas society is thought as being something equal to the "established order" or the "ruling classes"), but instead (as a substitute) the environmental movement.

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[5] Please note, that the "social construction of reality" argument could, of course, be discussed more appropriate by citing other authors (like Berger, Luckmann, Foucault etc.), who have been – and still are – more stimulating for the intellectual development of this really broad and multi-faced approach in general; cf., e.g., the overview given by Knorr-Cetina [100]. Nonetheless, with regard to the academic and public risk discourse, that is the particular focus of this paper, Douglas and Wildavsky have been – and still are – of upmost influence.

[6] The decisive statement of Douglas and Wildavsky ([41], p. 10) reads: "Our argument is that a complex historical pattern of social changes has led to values, that we identify as sectarian, are more widely promoted. The sectarian outlook has three positive commitments: to human goodness, to equality, to purity of heart and mind. The dangers to the sectarian ideal are worldliness and conspiracy. Put into secular terms, worldliness appears in big organization, big money, and market values".

[7] Douglas and Wildavsky themselves describe their own position as "centralistic": "Since we do not know what risks we incur, our responsibility is to create resilience in our institutions. But by choosing resilience, which depends on some degree of trust in institutions, we betray our bias toward the center" ([41], p. 198).

Since the risk-management of the industrial societies has been freed out of the grip of a purely technological-scientific (objectifying) as well as a purely cognitive-psychological (subjectifying) handling, this approach contributes valuably to the progress of risk-research in so far as the – up to then neglected – socio-cultural approach is strengthened [44,45]. It needs to be mentioned however, that their constructivism merely deals with the (ideational) processes of risk-*construction*, but not with those of the (material) risk-*production*.

Its (exclusive) explanation-claim closes indeed the gap, left by the risk-psychology. The risk-psychology provides the understanding of individual differences in recognizing and accepting risks, but leaves the question open, why a variance of certain patterns of risk-preferences and -aversions can be observed within the population. The answer is thought to be the different socio-cultural contexts, in which individuals live, the orientation of their thinking and acting towards certain institutions, leading to a whole typology of consciousness and behavior leading tendencies [46,47,48]. The different biophysical conditions of the individuals' environments and their alteration don't play any systematic role in this approach, not even as a constitutive element within a multi-factorial explanation-model of particular risk-cognitions. Why are nomads afraid to die of thirst? Since their culture requires it? Or: Because they live in the desert? The motives, which are supposed to lead to a change of cultural-institutionalized perception-, processing-, and action-preferences remain inexplicit [49]. Are they only culturally caused? Or are they related to the accumulation of events and experiences, occurring as an indication of aggravating ecological problems? Sociologically it is therefore by all means imperative, to examine as well the structures of the material production of risk in and by society.

Instead culture is being presented as the only "explanans". Their (rhetorical) question "*are dangers really increasing or are we more afraid?*" (Douglas and Wildavsky [41], p. 1), is (th-) ought to be answered merely by: "*We are more afraid!*". The phenomenon of "growing environmental and technological risks", which requires further explication, is merely diagnosed as the *result* of growing sensibility towards these risks, *caused* by processes of cultural change. Douglas and Wildavsky represent thus a radical thesis: Cultural processes of change are putting the individual into a state of uncertainty. The individual is looking for an object to project its anguishes onto and finds it in the form of environmental and technological risks. This thesis implies that the anxieties manifesting in this way – in the same way as the whole discussion about an "ecological crisis" – are actually (or leastwise in their tendency) misleading and unfounded.

An objectifying grasp on the question, whether increasing technological and ecological risks really exist or not, is being *methodologically* prevented. Likewise from the very beginning the fact that actually an industrial risk-problem might have developed which would have to be understood as the *cause* of the *effect*, namely the grown sensibility towards these risks, is not being considered seriously.

This approach is one-sided in so far, as processes of the industrial-technological reproduction and formation of society become non-investigable. They are – like the factors of the "natural" environment – understood as something *extra-societal*. According to the sociologist's dogma (of Durkheimian origin), which says "social matters can be explained only by social phenomena", they are no longer to be comprehended as subjects of social sciences research, because constructivism defines "social facts" to be equivalent to "social constructions" (thereby denying as well any kind of objectifying sociological investigation of e.g. poverty as some kind of substantial social problem besides its communicative and discursive existence as social construction and theme of debate).

6. Considering the Realist Approach

The realist approach comprehends "risks" as objective elements of interaction between nature and society. It explains the "increase of environmental and technological risks" through the intensification and extensiveness of nature's utilization. According to Dunlap [50] – one representative of this approach, who has been selected here in order to exemplify some crucial points while reporting and considering his theses – the environment has to fulfill three essential functions for society, namely a) to provide it with resources ("supply-depot"), b) to absorb its refuse ("waste-repository") and c) to serve as "living-space" and habitat of man.

If now an environment is used by one function, the other two are impaired. Given this setting there emerges a twofold "Gestalt" of human societies' ecological problematic. As a *social* effect of this interaction *utilization competition* and *usufructuary conflicts* ensue. The *ecological* systems – on the other side of the coin – are affected by *pressures*, which in the extreme disrupt their capacity to regenerate.

If during the progression of industrialization the ecosystem "Earth" is increasingly utilized, the following ensues:

1) The three utilization circles overlap more and more and an aggravation of negative interactions among them ensues.
2) The simultaneous expansion of all three functions leads to a transgression of the global carrying capacity or the environment's "ability to withstand" the stress.

In the sense of this double shaped ensemble of usufructuary competition and degradation of the "environmental space" Dunlap [50] purports: An *original* ecological problem of the society subsists, manifesting in increasing practical problems and growing risks concerning the guaranty of the three basic functions. This problem will remain incomprehensible, if it is understood reclusively in the framework of the "construction of social problems" as a *genuine* phenomenon of social cognition and communication. The growing social attention towards environmental and technological risks is therefore in essence a responsive reaction to their actual increase.

A critical review, dealing with Dunlap's statements constructively, needs to point out two clusters:

1) The model of the three social functions of nature are in a shortened form anthropocentric-utilitarianistically established – same as the concept of "environmental space" [51] inherent to the studies of "Sustainable Netherlands" [52] and "Future-Oriented Germany" [53]. An elaborated eco-systemic structure or at least a link to the ecosystems research and modeling (es e.g. offered by Holling [54]) is missing. Since temporal and spatial dynamics stay inexplicit, a systematic distinction between short term limit-transgressions, which can occur without causing irreversible damages, and long term strains is not possible; nor a distinction between positive and negative synergism-effects, accumulation-effects and threshold value-mechanisms. Systematically unexplained is also the distinction between ecologically harmless utilization-forms, "disturbances" that can be counterbalanced, repairable or renaturable interventions and irreversible damages.

   Also the possibility of positive interactions among the three functions is neglected, like for instance between an agricultural utilization and tourism. Another form of possible positive interactions, between one utilization function and some correspondent ecological condition parameters, like for instance between adapted agriculture and biodiversity, is equally neglected. Since an attempt to cover the dynamics of anthropogenic induced environmental changes and their repercussions upon society has not been made it becomes also impossible

to evaluate, how the shifts of problem-causes and effects are taking place. Because ecological after-effects of anthropogenic induced environmental changes frequently do not affect the party responsible, but affect – temporally and spatially shifted – entirely different actors, they do have far reaching consequences for the social appearance and performance of conflicts, molded by externalization-phenomena. Additionally it must be said, that a critical discussion of the employed carrying capacity-concept is not taking place. It could reveal the capacity-concept's population-ecological pattern in favor of the dependency of corresponding "limits" from socially shapeable technologies, procedures, and need patterns, of social practices and material life styles.

2) Dunlap doesn't associate the model of the three societal environmental functions with a sociological-theoretical approach, that could take up the following questions: Which socioeconomic structural achievements produce certain material- and energy-flows [55,56,57] within society and which functional prerequisites in the form of supra-technological infrastructure-systems, suitable institutions, and media are needed for their control? The point is that this question – in connection with a model of functional societal differentiation – determines also the attempt to answer the central question, why certain environmental problems are intensely heeded whereas others – sometimes "objectively" equally important ones – are neglected, respectively why certain problems seem for some sectors of society extremely important and for others not. An approach of this kind is necessary however, if one wants to explore, whether (and how) modern society can adequately perceive and process ecological problems and respond accordingly [58,59].

A crude sketch of Dunlap's approach shows that its strength lies in its possibility to develop footholds for integrated ecological and sociological problem analyses and strategies to cope with occurring crises. Its weak point is the lacking concept to explore the question: In which ways are ecological hazards communicatively processed? And: Why are they either adequately, insufficiently or not dealt with at all? Here the perspective is implicitly designed to reconstruct the processes of social perception and constitution of environmental problems along the occurring disturbances of utilization (or rather utilization-*expectations*) by using the three functions. But then it would be inadequate to view utilization-"impairments" still one-dimensionally as objective functional restrictions for arbitrary purposes. They rather ought to be

understood as corresponding to the different subjective or rather system-relative utilization-intentions of different social actors.

7. Considering a Synthesis

Risk-constructivism and -realism are blocking each other. Their synthesis, however, lies at hand, since both offer important cognition opportunities to enlarge scientific understanding.[8]

Krohn and Krücken ([60], p. 13ff) resolve the difference of both approaches "meta-constructivistically". They understand the naturalizing risk-objectivism in itself as a culturally dominant, construed thought pattern. According to them, the risk-objectivism doesn't have more epistemological importance, than the culturalizing risk-constructivism, under which it is subsumed in reference to its cognition potential and its validity.

My synthesis, however, resolves the difference of both approaches "meta-realistically" (exactly the other way around): The cultural priority of science is the result of the practical possibilities – of managing actions interfering with realities – opened up by science. The validness of risk-constructs is not (entirely) reducible to their social genesis. Their cultural weight is (essentially) obtained by identifying their potential ability of coping with practical problems and real dangers.

The following five theses examine the relationship of risk-constructivism and -realism and give an assessment of the points of the ("meta-realistic") synthesis:

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[8] The three starting points of the following considerations may be also described by referring – on the one side – to an insight formulated by Kasperson ([101], p. 163) who emphasizes – in response to critics, stating that "the social amplification of risk suggests (…) a 'true' or 'objective' risk and a 'subjective' or 'distorted' risk" – that according to his view "risk is a composite of physically *and* socially induced effects" (emphasis added). Moreover he makes us remember the "oft-forgotten truism of risk analysis – that damage to people and what they value is the product of environmental or technological threat, human vulnerability to such threats, and values". The other reference is with Rosa [102], who said that "risk analysis's principal *raison d'être* is to inform policy and other public choices". Risk science therefore can not be done without building bridges "between theory (what is) and public philosophy (what ought to be)". The third starting point may be defined in more theoretical terms together with Jaeger et al. ([103], p. 18); they claim that any consideration of risk as a feature of modern society has to take into account some three simple observations: 1) "Individuals, collectivities, and institutions perceive some risks, but not others"; 2) "Some risks engender concern, or alarm, while others are unconsciously or willfully ignored"; 3) "Some attract professional attention, including management practices; some do not". Determining the very nature of risk, therefore, needs to include not only the moment of potential harm or damage, but also that one of choice driven by diverging values and evaluations of the human actor [104]. Embracing both moments, that of its contingency as well as that its perspectivity, risk can be defined – according to Jaeger et al. ([103], p. 17) – as a "situation or event in which something of human value (…) has been put at stake and where the outcome is uncertain". Consequently, concerning the "existence" of risk, there is to say that although "risk may be viewed as an ontological state of the world, humans neither ignore that world nor are they passive about it" ([103], p. 18).

1) Ecological and technological-"risks" are to be understood as products *and* constructs of social actions *and* social communication in their context of material *and* symbolical interaction between nature and society.
2) Both the approaches of constructivism and realism offer *necessary* elements for the explanation of the phenomenon of growing ecological, technological, and health-risks. Independently, however, they are not *sufficient* to incorporate the risk-problems of industrial society. The examination of the social dynamics of actual dangers and risk-sensibility demands finally a combination of both approaches.
3) Publicly debated is not just the evaluation of risks but also their ontological status. Risk-constructivism and -realism are *meta-positions* within the processes of social debate and orientation, catalyzing the ongoing (materially and symbolically) changes of the relationship between nature and society. Within the debates about the reality and the assessment of risks their function is to stabilize those arguments that are – promoted by particular social actors – leading to some re-valuation or de-valuation of certain risk-definitions.
4) Measures for the reduction of technological and ecological risks go along with steps to optimize the interactive relationship between nature and society. The risk-debate cannot be looked at separately. It needs to be seen in its context with the debates about ecological modernization and sustainable development.
5) "More" reason (rationality) while dealing with the physical-ecological conditions of social actions is achieved by participative procedures, which are increasing the (inter-subjective) transparency of societal debates. The recognition and processing of risk-problems is accomplished by the participants of all sides more efficiently (differentiated according to subsystems, professions, cultures etc.) and by doing so the potential of societal self-organization is augmented (in favor of the whole societies reproductive capacities).

The plea for a *constructive realism*[9] as some pragmatic reflection of socio-ecological interdependencies does not mean to take sides within a technocratic narrowed risk-debate. It does not make any sense, however, to generalize the sciences in a relativistic manner, neglecting their competencies for practical problem solutions, which are necessarily bound to their specific potential of recognizing and analyzing realities [61,62]. The argument, that the (natural) sciences are producing just – as other social actors – constructs of social knowledge, which are unaware of their social genesis (that is thought to determine their validity) and thus produce merely a myth of objective knowledge, indeed hits upon a part of the difficulties, namely the *competition among different forms of knowledge* for the primacy of delivering *orientational knowledge* to society. But it misses another point. The argument ends at the latest there, where the corresponding *operational knowledge*[10] of the sciences has become necessary to recognize and cope with dangers, which are generated exactly by the foregoing application of this knowledge in the scientific-technological practice of a modern industrial society.[11]

A *polycentric model of societal knowledge*-production, -reproduction, and -utilization does not imperatively require a relativistic leveling down of all types of knowledge. Rather more important is the recognition of the specifics of heterogeneous knowledge-forms [63,64,65].

Believing in science in the sense of a positivistic monopoly-claim on truth remains neither desirable nor viable. But acknowledging an informed, self-reflexive science (a science that understands its own operational performance using critical reflection) is by all means appropriate. It doesn't demand faith, nor does it need to impel its competence in an authoritarian and dogmatic

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[9] This term ("constructive realism") is to express the programmatic sense, while the other ("meta-realistic synthesis") underlines the reflexive sense of the same idea. Please note, that my decision to use this term was made originally without any knowledge of the person and work of Fritz Wallner that I have become familiar with during my visiting professorship at the Institute for Philosophy of the University of Vienna during the winter term of 2007/08. As a direct consequence of this coincidence I am now in the position to foster my argument while citing him: "The differentiation between reality and environment does not aim at a relativism of knowledge. Nor does it aim at giving up the idea of knowledge at all. Its purpose is to avoid surrendering ourselves to the success of our constructs in the environment. The environment cannot be understood. We can only master environment with the help of our constructions of reality. If they serve us well for gaining control over the environment, we keep them. If they don't, we discard them. When it comes to knowledge, however, we can only refer to reality, i.e. to what we have constructed" ([105], p. 38f).

[10] The distinction between "operational" and "orientational" knowledge is made on the background of Habermas' [106] classical work on "Knowledge and Human Interests", where he draws a difference between "instrumental", "practical" and "emancipatory" functions of knowledge.

[11] Religious, esthetical, mythological or "post-modern" motives are surely very valuable, above all regarding the demands of such "societal relations to nature", which by some actors were qualified as "healthy", "pacific" or as "standing in accord or harmony with nature". They are not in the position however, to develop means and methods to resolve the industrial-society's environmental and risk-problems.

way. It has the chance to unfold its competence within a forum where questions of validity and value-judgment can be reasonably and openly discussed, so that a mutual enrichment can take place, by combining nonprofessional's logic with expert's logic, and everyday-knowledge with special-knowledge (cf. the procedure outlined by Shrader-Frechette [66], the more general arguments given by von Schomberg [67], and the comparison of strategies from Klinke and Renn [68]). The decisive resource for ensuring the effectiveness of intervention-strategies and risk management procedures rests according to Macgill and Siu "on the quality of the knowledge (scientific and social) on which they are based, and on the internal congruence of that knowledge" ([69], p. 1105). Each adequate paradigm therefore needs to be either reflexive as well as programmatic insofar as a balanced view of the whole risk issue has to combine two essential requirements that sometimes seem to be antagonistic: Without *communicative understanding* a solution of the ecology- and risk-problems of industrial society will be impossible; but without *scientific research (and innovation)* it will be impossible too!

8. Modeling the Dynamics of Risk-Sensitivity and Real-Endangerment

The following considerations about the relationship of risk-sensitivity and real endangerment are executed in form of a model, introducing the thesis of a validation of social risk constructions by processes of testing their applicability in reality. The model elaborates the consequences of different strategies to deal with risks, independent of the question what kinds of methods and procedures are appropriate in order to distinguish "genuine" risks from "ostensible" ones. The underlying assumption is, that not only processes of the dramatization and scandalization of risks are resulting in negative effects on society's welfare (Kasperson et al. [70]) but also the belittlement and trivialization of those risks.

Assuming, that at the points A, D and G, lying on the symmetrical axis p, a reasonable ratio of risk-sensibility and real endangerment is prevailing, the following can be established:

- to the right/below: their proportion is incommensurate, as the growing endangerment is not counterbalanced by more sensibility, necessary to encounter and check the dangers adequately;
- to the left/above: their ratio is also incommensurate, as decreasing risks are not accompanied by a decrease in sensibility;

- to the right/below of p: increasing risks are not adequately checked by measures of risk-minimization or compensation;
- to the left/above of p: decreasing risks are not accompanied by cutting back the use of means (and by giving room for more opportunities).

En détail the graphics gives information about several points indicating different relationships of real endangerment and risk-sensitivity related to the acceptance of perceived risks:

A: Point A is a hypothetical location of stability. The sensitivity towards risks is constant. The real endangerment neither increases nor decreases. We assume, that at this point the risk-situation is accepted in society and that the relationship of risk-sensitivity and real endangerment is adequately developed.

B: The sensitivity towards risks remains constant, but the real endangerment has increased. Assuming, that at point A the perceived risk has been accepted, we have to conclude for B, that the risk-situation is no longer being accepted and that demands for risk-control or compensation occur.

C: At point C the endangerment remains constant, but the sensitivity towards risks has increased. Under the premise, that at A the risks were accepted we have to conclude, that at C they are not accepted any longer, because the sensitivity towards them has increased.

D: At point D the sensitivity towards risks has increased and also the real endangerment has increased (in equal ratio). At D there is no acceptance towards the perceived level of risks (to the right/above the axis q), but the relationship of sensitivity and endangerment is quite adequate (the increasing sensitivity has counterbalanced the increasing endangerment – point on the axis p).

E: At E the risk-sensitivity has decreased, but the real endangerment remains constant. The risk is accepted (overflow of acceptance), because the point lies to the left/underneath of the axis q, and the relationship of risk-sensitivity and real endangerment is inadequate, because the point lies right/underneath of axis p.

F: The risk-sensitivity has decreased at the point F. The real endangerment is going to increase. The risk is exactly accepted, because the point lies on the axis q. The relationship of

sensitivity and endangerment is quite inadequate, because the point lies far to the right/below of the axis p.

G: As the risk-sensitivity is decreased, the real endangerment is going to decrease. The conclusion is: the risk-situation is accepted (because underneath q), and the relationship of perception and reality is adequate, since the point G is lying on the axis p.

H: The risk-sensitivity remains constant, while the real endangerment has decreased. The conclusion is: the risk-situation is accepted (because to the left/underneath of the axis q), and the relationship of perception and endangerment is inadequate, because to the left/above the axis p (overflow of concern).

I: The risk-endangerment has strongly decreased, but the risk-sensitivity is actually increasing. The conclusion is: as the point lies on the axis q (as also F), the risk-situation is exactly accepted, and as the point I lies to the left/above the axis p, the relationship is inadequate, because over-concern requires the engagement of to many resources causing a reduction of chances while the risks are actually decreasing.

The points I, A, and F are situated on the axis q, indicating, that the risk-situation is exactly accepted. If we start from the axis q in the space to the left/below of it, the risk-acceptance decreases with increasing distance to this axis. If we move in the space to the right/above of axis q, the non-acceptance of the risk-situation increases with the growing distance to this axis.

The parallels to p or q are lines of indifference. Therefore the perceived risk at the points 1 and 2 is equally non-accepted (parallel to q), but at point 2 with an underestimation of the real endangerment and at point 1 with an overestimation. At the points 2 and 3, the relationship of risk-sensitivity and real endangerment is equally inadequate: the real endangerment is equally underestimated (parallel to p), but the perceived risk is not accepted at point 2, while accepted at point 1.

Field I: A relative surplus of worry results in the real risks being overestimated; $\Rightarrow$ a too high use of means to their decrease and compensation; the relative non-acceptance of the perceived risks results in a situation where inevitable damage-consequences are being tolerated in a too small measure and leads, instead of this, to the tendency of changing to alternate practices with a possibly more unfavorable ratio of chances and risks.

Field II: A relative surplus of worry results in the real risks being overestimated; ⇒ a too high use of means to their decrease and compensation; the relative acceptance of the perceived risks leads to the tendency to avoid the change to other practices with a possibly more favorable ratio of chances and risks; instead of this damage-consequences are tolerated in a measure which would be avoidable.

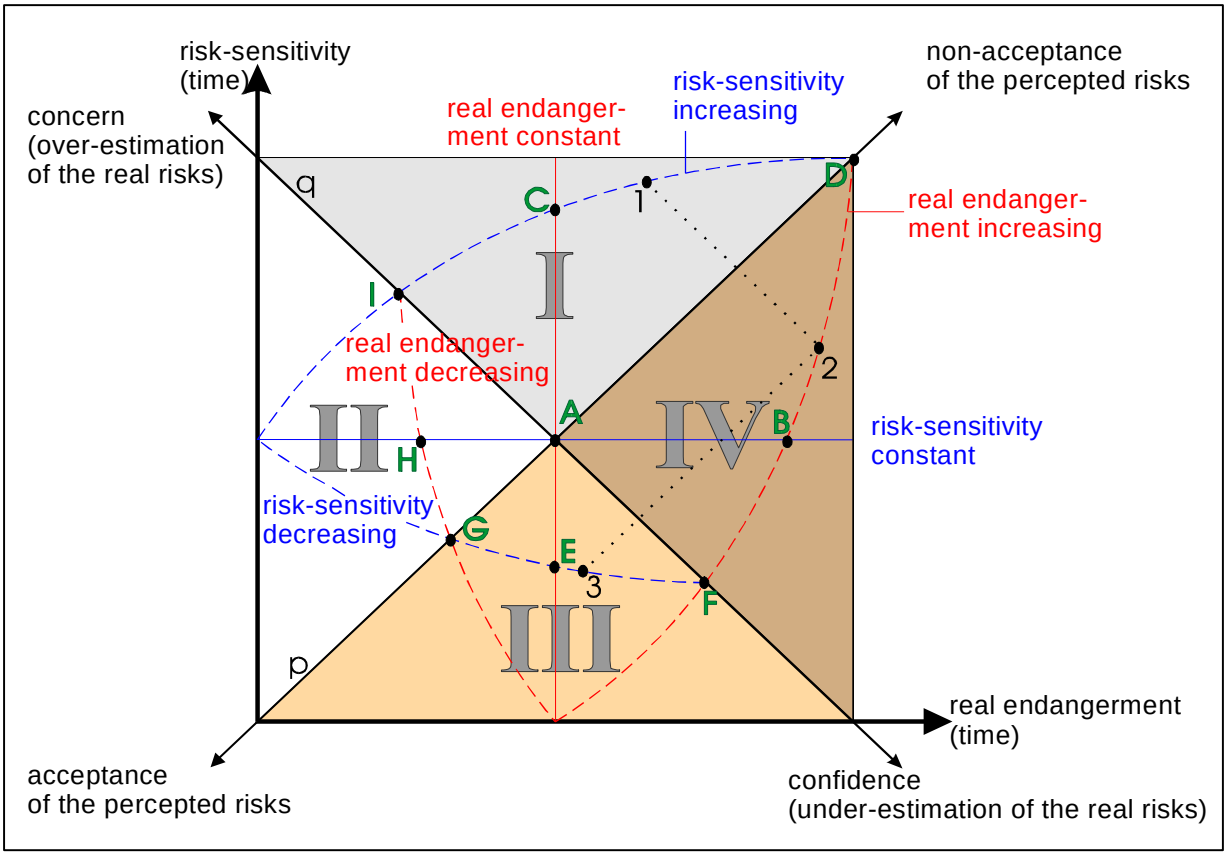
Field III: A relative surplus of confidence leads to the underestimation of the real risks; ⇒ a too low use of means to their decrease and compensation; the relative acceptance of the perceived risks results in a situation where the change to other practices with a possibly better ratio of chances and risks remains undone in the tendency; instead of this damage- consequences are tolerated in a measure which would not be necessary.

Field IV: A relative surplus of confidence leads to the underestimation of the real risks; ⇒ a too low use of means to their decrease and compensation; the relative non-acceptance of the perceived risk results in a situation where the change to other practices with a possibly worse ratio of chances and risks prevails in the tendency, while relatively unavoidable damage-consequences are not being tolerated.

The fields I to IV display the possible combinations of acceptance/non-acceptance[12] and confidence/worry and refer thereby to a relationship of perceived and real risks to be understood relatively to that. The difference of risk sensitivity and real danger becomes in this way combined with the mental distinction of the societal over- or underestimation of the actually existing (environment- and technology-) risks. In this way the possible consequences of the chosen modus of dealing with risks could be differentiated and rated. The "ambiguity of risk" [34] can so be described unequivocally with regard to its consequences. The discussion of the consequences considers 1) the ends/means-relation (too little or too much means for reduction or compensation relative to the existing risk), and 2) the relation of risks and chances (change to other practices with a possibly better or worse ratio).

[12] This model does not allow the derivation of propositions on the issue of acceptability. The degree of the acceptance and/or non-acceptance of risks varies in this model (in contrast to its performance in society) independently of their perception. Whereas tendencies of the over- or underestimation of risks could be indeed regarded as a function of confidence/worry, this is not valid for the acceptance, because also great risks can be accepted, while small ones are not-accepted, independently of the socio-psychological tendency to overrate non-accepted risk while playing down accepted ones. Here therefore further factors are coming into the play that are not part of the graphical representation.

Graph. 1: Risk-Sensitivity and Real Endangerment – An Evolutionary Model



The model illustrates the thesis, that *parallel running changes of real endangerment and risk-sensibility are evolutionary supported*. Meant is not progress, but simply a process, producing changes that have to "prove themselves worthwhile" (cf. Burns and Dietz [71] as well as Popper [72], who figured out an essential part of this argument). The testing-mechanism is to be understood under socio-cultural conditions as a double one. *Social practices* and their corresponding *socio-cultural constructs* are socially formed. They are subject to a selection by their socio-cultural environment, insofar as they have to be evaluated in processes of publicly and institutionally bounded communication. Thereby the principle of test and trial in the biophysical reality is indeed not discarded – but mediated. Certain social practices or technical innovations might be strongly preferred out of cultural reasons. If they fail or miss the conditions of biophysical reality insofar, as they cause high costs, require a high expenditure of work, function only poorly or are simply impracticable, the cultural preference for them will be devalued sooner or later.

9. The Society and the Functions of Socio-Cultural Risk-Constructions

Our unique alternative is not that one of to choice between some naïve materialism, reflectionism or positivism and a not less naïve idealism, subjectivism or voluntarism. In contrast to this duality of viewpoints, I share the opinion of Horlick-Jones and Sime ([73], p. 447) that the really interesting questions arise "when one starts to consider the relationship between the ontological nature of an entity and the categories we use to describe it". Then we need to ask questions like "To what extend does that entity's 'innate nature' demand that its description takes a certain form?" (ibid) or "Conversely, to what extend do ideological and value 'spin' impose our 'way of seeing'?" (ibid). And, on this background, also their conclusion makes sense to me, insofar as they highlight that "The dynamic, therefore, is a tension between materiality and sociality" (ibid).

This "tension" in mind I like to argue, that the function of risk-constructions is not to be understood as a single one. Risk-constructions have multiple social functions related to the functions of societies in general and to their differentiated social subsystems (like economy, science, politics etc.) especially. The decisive point is that the function of risk-constructions is not limited to the sphere of societal communication. The functional effectiveness of risk-constructions is observable not only in the field of the structuring of discourses, but lies as well in the field of the regulation of the metabolism of societies and their ecological environment, maintaining the material basis of societies and their human populations. Recognizing both functions demands and allows for making use of an analytical approach that identifies the problems that emerge out of their dynamic interdependence. One of them is the life-cycle or performance of risks over various time-spans (cf. the typology of the German Advisory Council on Global Change [74] as well as that of Rejesky [75]) which is coupled to the in principle ever possible and in practice often observed non-synchronism of running discourses and gathering experiences, of attentive phases and the occurrence of events.

The cultural studies oriented conceptual framework of risk-research is too narrow. Analyzing risks is allowed only related to social and cultural conditions and their effects on risk-constructions. A conceptual framework that allows saying, that risk-constructions perform existential functions as well as communicative functions, is preferable, because societies cannot be reduced to mere systems of communication – they are also systems of action, which set

material goods into motion, transform energies and build up the material infrastructure of society's existence [76].

The structural and functional affinity between futures studies and risk analysis – that provides a mutual invitation for harnessing its particular advantages – originates exactly at this point. Here they share the basic assumption that human actors "by their behavior constantly shape their natural and social environments and, in so doing, shape their own future, although not always in ways that they intend or understand" ([77], p. 33). And because of the fact that the process of shaping the future includes inevitably that one of shaping a path-dependent topology of risk and vulnerability [78,79] there is need to make use of this affinity – in theory by a mutual enrichment of research methodologies and techniques of forecasting [80] as well as in practice by an interchange of data, results and conclusions – in order to transform the uncertainty and openness of the future according to a common strategy that could best be expressed with Bell [85] as one of identifying the 'possible', forecast the 'probable' and choice the 'preferable'. Additionally there is to say, that the program of studying vulnerabilities and analyzing risks needs to be expanded in the direction of hypothetical questions and scenario-dependent tasks in order to become able to assist and accompany a twofold program that tries to provide for both: on the one hand for the critical deconstruction and review of common images of the future [81] and, on the other hand, for the mobilization of social fantasy and creative forces while opening up space for alternative views, discourses and challenges to the status quo [82]. A good possibility for accompanying this approach that focuses on social innovation and its pathways is to provide a program for "vision assessment" [83] that centres more on technology-driven scenarios.

The above mentioned thesis which integrates the two societal functions of risk will be expounded in the following three points in the sense that a validation of risk-constructions takes place corresponding to social practices:

1) Environmental, technological and health-risks are – like other risks too – symbolically formed within the space of communication. As social constructs these risks "exist" conceptually in a symbolical way. But symbols are not only phenomenal elements of worlds of social meaning, but refer to something lying outside of themselves: to real interdependencies between actors and artifacts which can be ecologically, technological or medically (de-) or (en-)coded [84]. If expectations which are linked to symbolical representations of risks are thwarted or frustrated, constructs are *devalued*; because a

constituent part of each risk-construction is a reflexive link (or reference) on the reality of itself (on a possible risk-reality related to the propositional truth-claim). Decisive for the truth of a risk-construct is not only its cultural weight, but also its capability to bring expectations in accordance with events.

- The accident of the Chernobyl-reactor is a good example for this thesis, in so far it can illustrate the "phenomenon of reality breaking into a social or intellectual system" ([85], p. 267). It made it unmistakably clear to a wide public, that the faith in the safety of nuclear energy needs to be re-evaluated.
- A less dramatic, but not less consequential example is the production and consumption of large quantities of CFCs, which was regarded by experts for a long time as harmless, as nearly ideal – chemically inert – propellant gas with manifold operational possibilities. Through the occurrence of the "hole in the ozone-layer" and the causal evidence of a nexus to the concentration of CFCs in the atmosphere one risk-construct (the harmlessness of CFCs) has became devaluated in favor of another one (that of their eco-toxicity.

2) The capability of risk-constructs to bring expectations in accordance with events is equivalent to their capacity of regulation in dealing with realities. If events, which are actually a threat, like e.g. the occurrence of an epidemic, are not adequately represented by corresponding risk-constructs, the practical options of a successful management[13] of these imperilments are likewise limited.
   - If for instance the possible occurrence of cholera is culturally encoded in such a way, that it can be only interpreted as the consequence of a normative deviant behavior, but cannot be related to hygienic reasons, then the threat of this illness for the cultural stability might be indeed fended off, by blaming a witch as the responsible party – however, the chances of overcoming this existential threat posed by the cholera epidemic would be much higher under the conditions of another cultural encoding of this health-risk.

[13] At this point I would like to underpin the value of the discussion between the viewpoints of positivism and constructivism written by Peschl [107] especially insofar as there is a comparative consideration of "to generate functionally fitting behaviour" as crucial point inside of both of the two alternative ways of describing the relationship between the world and its representation, in particular with reference to scientific knowledge and its underlying cognitive processes.

We could say, that the *social validity* of a risk-construct depends on its cultural weight, on its capacity of stabilizing a certain order of social action (or – in times of revolution – of changing them in an intended way), whereas its *factual validity* depends on its practical potential while treating (or handling with) realities.[14]

Because of the cultures' inherent capacity to learn, their negative and positive experiences with the factual validity of constructs, as they occur in the context of social practice, are converted into a minus or plus of the social validity of these constructs. The social validity of constructs is thus anchored – mediated by these processes of their de/re-valuation – without further appeal in their factual validity. This connection is the feebler, the less effectual cultural judgments are.

- If one follows for example the prescription of the Inca moon-calendar to dye wool only during full moon, this social practice probably has no further advantages or disadvantages, and can consequently be determined nearly complete culturally.
- If the consequences are, however, on a much larger scale, the cultural valence of a social practice depends more on natural factors. An example is the "Potlatch" of North-American Indians declaring fishing – among other issues – during the times of the fishes' reproductive phases taboo. This verdict has an ecologically regulative function with reference to the sustainable use of a central nutrient-resource, but fulfills also redistributive functions ([86], p. 132ff).

3) Processes of experience-accumulation and learning are connected with expenditure just as in the case of experimental action. The society's costs of risk-constructs are composed of:
   a) the harm, arising when risks emerge,
   b) the costs of measures for prevention, minimization or compensation of risks,
   c) the opportunity costs, which arise, when the means bound by accepted risk-constructs are no longer available for the pursuit of other targets, and
   d) the transactional costs of measures for the exploration and evaluation of risks as well as the costs resulting from the change of practices, methods or technologies.

   The under- or overrating of dangers has in any case cost-relevant consequences: When the relationship of risk-constructs and risk-realities leads to an *under-estimation* of a real danger

[14] The diagnosis of "Late Lessons from Early Warnings" [108] is a characteristic case of the discrepancy between the two just mentioned forms, but also for the learning process taking place over the time.

(independent of the base of this "false-construction" or whether it could be prevented or not) the ensuing result for society are damage-costs (a) on a much higher scale, then would be basically necessary. When their relationship leads to an *over-assessment* of the real danger, prevention- and compensation costs (b) as well as opportunity costs (c), are also much higher then would be necessary. Generally the same is true for the transactional costs (d). When practices, methods or technologies are replaced by different ones, the changeover expenditure plus the effort of information for the clarification of the advantages is only then justified, if overall the amount of the transactional costs is less, than the difference of damage-costs (a) and the sum of the risk-reduction-, compensation- (b), and opportunity-costs (c).[15]

10. Conclusion: How to Comply the Responsibilities of Social Sciences Risk Research?

One might object now, that the society takes only the costs of those damages into account, which are verified by its valid (or better: accepted) constructs that are in practice equivalent with its ordinary measuring instruments. The gross-national-product (GDP), which doesn't register "socio-environmental damages" (as tentatively defined by the European Commission [87]) as costs, but credits them even positively, because income is obtained by managing their after-effects, is a well-known but still valid example to illustrate, how also the quality and validity of measuring instrumentation become increasingly controversial when, as in this case, effects run contrary to their logic.[16]

Independently of the fact, whether they are adequately perceived and economically taken into account, these damages have considerable consequences for social practice. They burden society and have to be mastered in some form. The more adequately these "external costs" are perceived

[15] Using this model could especially be helpful in order to compensate for a deficit of the "social amplification of risk approach" [67,79] identified by Rip ([109], p. 193) in so far its "focus as well as the concern is about intensification and the additional social costs accompanying 'exaggerated' responses" while neglecting "the social costs of attenuation of risk". The same is true with respect to Lomborg [110], because his plea to "keep cool" in front of the global climate change in order to avoid useless expenses remains one-sided.

[16] One of the best illustrations of this mechanism might be a clear-headed analysis of modern Chinas forced industrialization politics. A recent synopsis, compiled by the U.S. Embassy Beijing Environment, Science, Technology & Health Section [111] concludes that considering "the differences in methodology, approach and coverage, estimates of the cost of pollution to the Chinese economy produced by Chinese and Western environmental scientists and economists are fairly tightly bunched between 3 and 8 percent". Therefore it is to be feared that: "The value of human and natural capital destroyed each year by pollution and ecosystem damage could be canceling out the increased output of material goods and services". With regard to the famous Chinese

and processed "constructively" the easier it is for the social practice to alleviate the burden and to reinvest the released means in a creative manner (at best in order to mobilize all innovation-potentials directed to strategies like "ecological modernization" [88,89] or the "sustainable knowledge-based society" [90]). And exactly this is our task: to estimate risks as much as possible "realistically" in order to be able to handle them as much as possible reasonably. There is no patent remedy for this task. Moreover the social handling of risks and the corresponding hazards remain always a matter of negotiation and comparative examination of goods. Does that mean that everything has to run along the same scheme as hitherto?

Two starting points, in order to redirect our efforts and make some progress, are:

1) To favor those concepts of risk that are able to work preventively and to resolve problems in the *context of strategies* of sustainable development, instead of securing only isolated techniques or environmental problems (cf., e.g., the typology of "risk-syndromes" established by the German Advisory Council on Global Change 2000 [74] as well as the link between "Risk Science and Sustainability" set out by Beer and Ismail-Zadeh [91]).
2) To tackle problems *multi-perspectively*, in order to – on side of the sciences – gain more understanding by using the changing perspectives of the particular disciplines. And in order to – on the side of the society – promote more reason through mutual insights of different horizons of experience and forms of knowledge in social practice (cf., among others, Jaeger [92] with regard to the relation between risk management and integrated assessment, Grunwald [93] and Newman [94] with concern to the nexus between uncertainty and sustainability, and Hjorth and Bagheri [95] for a systems dynamic approach covering this matters).

Modern societies do have an experience–horizon that is open to an uncertain future. They are proceeding huge parts of their internal contradictions and external challenges in the mental form of risks in order to bring them into calculable forms that are situated at the limits of the basic approach of rational decision-making. Each of the possible pathways into the future provides a particular mixture of chances and risks that can not be fully known in the present. The arising conflicts about all that knowledge that is relevant for our choices which are shaping our future are therefore – even if they become permanent – not to understand as some kind of disturbance. They

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story of success ("with annual growth in measured GDP of 7-8 percent") this means that finally – and despite all the efforts of hard working people – "the economy is producing little or no net new wealth".

are not a symptom of civilizational decay because they fulfil important functions in the face of all this, namely as movements of the search for orientation and providers of well-reflected information.

The social sciences are embedded inside of these interdependencies and conflicts. As professional actors, the social scientists are carrying therefore a particular responsibility for the living conditions of future generations as well as for all the present processes that are shaping our future. They have to contribute to the generation, critical reflection and evaluation of all that knowledge that is needed here. Therefore – and in particular in order to master the tasks posed by the modern societies risk problematic – they do best to elaborate their disciplinary capacities while cooperating with others. Sociology is indeed a theoretical *reflection-oriented science*, but it is as well an empirical *reality-oriented science* [96]. It is therefore legitimate, to deconstruct social problems and to solve or handle them in a discursive manner in order to elucidate their genesis. The other – not less legitimate – approach comprehends social problems objectivistic and substantially, in order to work out practicable action models and political strategies to overcome them.

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