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ORIGINAL ARTICLE

Modes of orientation provided by futures studies: making sense of diversity and divergence

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Abstract Debates about the future are an essential medium of modern societies' self-understanding and governance. In this context, future studies and reflections are frequently advising decision-making processes. But the considerable diversity of statements about the future and the divergence which often becomes apparent regarding the prospects of the future threaten the possibility of delivering the desired orientation. The more divergent the envisioned futures, the more providing reliable orientation might be without any chance of success. Against this background the aim of this paper is to distinguish three different modes of orientation which can be delivered by future studies and reflections. The mode 1 orientation corresponds to the decision-theoretical model: Statements about the future are interpreted as a reliable framework into which decisions and actions have to fit as good as possible. If future studies result in strongly diverse statements (e.g. in the field of energy scenarios), orientation is only possible in a mode 2 understanding: the futures form a set of diverse possibilities within which some "robust" strategies for action might be identified. But what is beyond this distinction? If futures would completely diverge between, so to speak, paradise and apocalypse, even the mode 2 approach would no longer work (this case applies to some recent debates on new and emerging sciences and technologies). For this case I would like to suggest a 'mode 3' type orientation: even diverging future studies' results can be made subject to a 'hermeneutics' of the present, where we can learn about ourselves from the diversity, variety and divergence of statements about the future. What we can learn from this consideration that there are extremely different ways to benefit from reflections on the future. Their feasibility depends on an epistemological issue: do images of the future in a certain context converge as soon as more reliable knowledge is fed in, or is diversity or divergence persistent?

Keywords Rational choice · Deliberative democracy · Epistemology · Decision-support · Divergence of future studies

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Introduction and overview

In modern society, political and economic decisions are mostly oriented by *considerations on the future* [1]. Taking *current* problem areas and diagnoses as starting point, we use *futures* studies, projections, and debates to get orientation *for today's decision-making* (e.g. in the field of technology assessment, cp. [2]). Debates about the future are an essential medium of modern societies' self-understanding and governance – and futures studies are a highly sought-after advisor. However, here we encounter a characteristic problem: futures studies are in many fields controversial, divergent or even contradictory with respect to their results, and contested [3] (Table 1).

The considerable diversity of the results of future studies and reflections which becomes apparent in specific fields is *prima facie* a threat for the desired orientation. In particular, in cases of divergence they create a significant doubt about whether we can learn from them at all for decision-making processes. If the statements are so far apart that we have to suspect large arbitrariness, the condition of the possibility of giving orientation would no longer be met. As is well-known, it is impossible to draw reliable conclusions from contradictory or arbitrary premises. If the divergence is too high then even the notion of "uncertainty" does no longer fit to the situation. Even a "reflexive governance" [4] would not be able to make sense of this extreme constellation. This

Table 1 Illustration of major properties of the three modes of orientation

	Mode 1	Mode 2	Mode 3
Approach to the future	Predictive: one future	Look for a corridor of sensible futures	Open space of futures
spectrum of futures	Convergence as ideal	Bounded diversity	Unbounded divergence
Preferred methodology	Quantitative, model-based	Quantitative or qualitative; participatory	Narrative
Knowledge used	Causal and statistical knowledge, laws	Models, knowledge of stakeholders	Associative knowledge, arguments
Role of normative issues	Low	Depends on case	High
Orientation provided	Decision-support, optimisation	Robust action strategies	Self-reflection and contemporary diagnostics

diagnosis is definitely not new (e.g. [5–7]; see also Sections 2 and 3 of this paper). However, there are at least three reasons to address it again in this paper:

First, it seems that the dramatic nature of the situation briefly sketched is still underestimated. After all, these findings question the prevailing theoretical model of society in general, according to which modern societies orient themselves by considerations on the future instead of the reference to the past (e.g. [1, 8]). Second, the observations of the diversity of the results of future studies are well-known in the futures research community and also reflected there [6, 7]; from the viewpoint of consumers and users of futures studies, however, things look different. Still there is often the expectation that futures studies can provide a clear orientation for future developments along which pending decisions can be "aligned", from which they can be "derived" and relatively to whom they can be "optimised". And third, a new optimism is currently emerging in parts of science that new methods in information technology, modelling, and, above all, enormous and increasingly connectable data bases (big data) open up new ways of prognostic access to the future – the aforementioned dramatic findings would be obsolete if this would work out. However, the question is if, under which conditions and in which respects this optimism is reasonable.

These arguments give rise, again and again to reflect on adequate ways of dealing with uncertainties but also with diversity and divergence of future studies, prospects, and reflections. The futures studies community does this now for decades, often along the distinction between foresight and forecast [5–7]. The specific and innovative focus of this paper is to consider in some more detail the degree of divergence of future studies and its relation with the respective type of orientation to decision-makers and society which could legitimately be drawn from those future studies and reflections. My proposal is to distinguish between three modes of orientation[1] referring to different constellations considering the convergence, moderate diversity, or divergence of futures in the fields under consideration:

- *Mode 1 orientation:* Decision-makers and the media often expect that futures studies give immediate orientation in the sense, as it is often put, to "derive optimal decisions" from futures studies. They are expected to provide a reliable framework for future development allowing that decisions could then be optimised in relation to this framework. This mode of providing orientation by future studies matches the decision-theoretical concept of "rational choice", and decision-making shall be supported by futures studies as a form of classic "decision support". Mode 1 orientation is, however, only valid if sufficiently clear causal knowledge is available allowing *converging forecasts* [5] (Section 2).
- *Mode 2 orientation:* If futures studies cannot provide a reliable and converging framework for future developments due to inherent and inevitable uncertainties or resulting from epistemological limits to knowledge, it is much more difficult to provide orientation. According to the state of the art of future studies orientation-building in this situation has to depart from a set of *different foresights* (often scenarios). The orientation given in this situation aims at identifying *robust strategies*, for example action strategies towards sustainable development [9]. A major point of my analysis is, however, that the diversity of future studies must not mean complete divergence or arbitrariness – otherwise even the derivation of 'robust' strategies would necessarily fail (Section 3).
- *Mode 3 orientation:* While the mode 1 and mode 2 orientation have already been discussed in the futures research community, mostly using the distinction between forecast and foresight, the remaining case – too high diversity or complete divergence of pictures of the future to allow for deriving robust strategies – has not found deepened interest yet. Providing orientation in this case seems to be impossible at the first glance – but there is a constructive way as will be shown in this paper: orientation can be drawn from analysing the diverging futures both *semantically and hermeneutically* (Section 4).

[1] This is a good occasion to express my thanks to two anonymous referees. Their feedback on an earlier version was essential to develop the approach of three modes of orientation.

This three-fold picture of different types of orientation to be provided by future studies and reflections in different epistemological constellations extends the current picture working with the main distinction between forecasts and foresights. Furthermore, it allows for relating epistemic and epistemological aspects (quality of the knowledge available, remaining and perhaps inevitable uncertainties; convergence, diversity, or divergence of futures) of future analyses in specific fields with specific types of orientation to decision-makers and society. And in addition, the approach allows transgressing existing borderlines between the futures research community (working mostly with mode 1 and 2 orientation) and other communities operating with other types of futures, e.g. in the field of visionary technologies, where mostly only mode 3 orientation is possible [10].

Disappointed expectations – mode 1 orientation

Orientation by considerations on the future was and is often introduced in a way as if the imagination of future developments could create a reliable framework which reduces the openness of the future considerably. This framework is ten expected to make it possible (probably even quite simply) to direct pending decisions, e.g. concerning regional development or the expansion of infrastructures, in a way that they ideally fit into this framework. By experience it is now quite clear that such expectations cannot be fulfilled in complex societal issues – this diagnosis based on empirical evidence shall not be repeated here [11]. However, there are critical questions on some premises of this mode which seem to shed light on some very basic methodological problems related with this approach – and which render the mode 1 approach extremely problematic even without regarding empirical evidence of its frequent inadequacy.

First of all, parameters for describing future developments are divided into two categorically different parts in the mode 1 approach. One part regards the future as a set of events and processes which result (more or less) causally from current knowledge and which are, therefore, basically predictable and foreseeable [8]. Regarding this part of the future, a deterministic understanding of history is hidden behind. The problems of the realisation of this ideal programme were of course recognised, but blamed on the complexity of societal relations, the insufficient data base and the to date poor knowledge of social and economic laws compared to natural sciences. So these difficulties are often regarded as a challenge which could be met by advances and effort in futures research methodology and seldom as a strict limit to prediction. Hopes for better mode 1 orientation by methodological or epistemological progress in the field of futures studies or by more and better data are based on this optimism [13].

However, the question of "optimal" decisions would not make sense in a generally deterministic understanding of history. Because in that case we would not have to give thought to pending decisions since they would be determined anyhow. Therefore there must be assumptions about a second part of the future whose course depends on our today's decisions and actions and is thus open for shaping. The mode 1 orientation by future studies is thus preceded by a fundamental distinction: the distinction between regularly running and thus predictable parts of future development on the one hand and other parts that can be influenced by intentional human action and decisions, on the other. In spite of the fact that this distinction is a necessary precondition of the mode 1 approach it is seldom a subject of discussion. This is a crucial issue because it is absolutely not clear a priori which facets of societal development fall into one or the other part, and upon which arguments this depends (cp. [14] for the question of social or technology determinism). Therefore, a severe lack of analysis and reflection has to be diagnosed.

A deeper look into the use of future studies in decision-making processes helps uncovering a second underlying assumption of the mode 1 approach which might become problematic. The decision-making process in the framework of a rational choice paradigm is about gathering all relevant information to get orientation for a "good", "right" or even "optimal" decision. The use of knowledge about the future as "important information" in this sense – which is exactly what mode 1 orientation would be – includes premises especially related to the term "derive" which is used here quite often. This term and/or the argumentative context assumed with it are, loosely speaking and certainly slightly overemphasised, used in two directions:

- First, particular developments or states of the future are "derived" from current knowledge in certain respects. In logical-deductive reasoning [12] today's knowledge of regularities and laws is the source for "deriving" knowledge on future developments. This covers exactly that part of the future which has been classified as being predictable already today (see above);
- Second, from this knowledge about the future decision-makers "derive" which decision out of a set of alternative options would be "optimal" for a specific question. This applies exactly to the other part of the future which was assumed to be influenceable (see above).

This approach follows the premise of the rational choice paradigm that, under optimal conditions for decision-making (i.e. above all with complete knowledge), there could be only one rational (and therefore optimal) decision. In this model, decisions – at least in certain respects – would be basically predictable from and determined by today's knowledge including the detour of forming knowledge about the future. In the framework of future developments which has been

"derived" from today's knowledge "optimal" decisions can in turn be taken as "derivations".

If we would succeed in obtaining such results from both forms of "deriving" – from today's knowledge regarding the future and from the future regarding currently pending decisions –, which clearly and with reason claim consensus then the search for the best decision would, in principle, be automatable in form of an algorithm. Troublesome and controversial debates and difficult negotiation processes would no longer be necessary. This is the latent (and technocratic!) ideal behind the mode 1 orientation by futures studies. Its basic structure can particularly be recognised by the fact that the space for the shapeable part – which has to be assumed first in order to be able to speak of alternative options for decision – finally disappears completely in the "derivation" chain. This is because this two-step "derivation" approach reduces the shaping to an automatable act. Or, to put it in another way: the distinction made above between one part of the future which was introduced as determined and one part which is considered as shapeable disappears due to the fact that the shapeable part is "derived" from the causal knowledge extrapolated to the future. Thus the deterministic part of the future becomes "encroaching" and also determines – via the figure of "deriving optimal decisions" – that part which was at first conceived as shapeable.

Now of course we have to ask if and to what extent scientifically generated knowledge about the future can meet such rational choice expectations at all. A closer look at practical usage creates doubt. The "double derivation" often does not work for the simple reason that knowledge about the future itself is often controversial and contested [3] and reveals deep ambivalence [10]. Instead of achieving "optimal" decisions we end up in controversy on different levels: about today's knowledge and its extrapolability to the future, about the introduced futures themselves and then also about the question if and with which argumentative force we can "derive" decisions thereof. Such controversies often express conflicts of a pluralistic society since debates about the future also include values, ideas of man, hopes and fears as well as concepts of a future society which of course reflect the different ideological and political positions. We may just think of the field of energy policy and the debates about when which share of the energy supply could be provided by renewables and what this may mean for the stability of the grids and the electricity price.

New methods of foresight, new algorithms and supercomputers or new ways of networking complex data bases currently spark hopes for at least a *future* realisation of mode 1 orientation by future studies. However, in principle we should be sceptical about this. The epistemological analysis of futures studies shows that the adoption of assumptions which are not backed by causal knowledge is inevitable for the construction of statements about the future [15, 16]. Statements about the future are social constructs that arise from actions taken by agents. Ingredients like knowledge components, values, assumptions of different quality and many others are used to create futures which are as consistent as possible. All this happens within the "immanence of the present" which can be left neither by logic nor by empiricism [17]. Futures studies do not provide information on the future *as such* but on how it presents itself in the context of specific constructions by certain actors. And there is a large difference between this boundedness to certain actors in societal fields and in scientific ones. While in the latter scientific communities, e.g. astronomers, can agree on knowledge about the future based on accepted rules, this does not work out in societal fields. Because futures can be constructed in very different ways here since only the *currently relevant* aspects can be taken into consideration for their construction and these aspects do not only include knowledge but also interests, values, assessments and considerations of relevance and priorities. These are normative and evaluative and can therefore always be denied. The inevitable result of this variety of today's assessments, especially in a pluralistic society, is the reflection of this variety in scientific futures and that it thus also necessarily entails its diversity [3]. The diversity of futures reflects the pluralism of the present – and renders mode 1 orientation impossible in many cases. This explains the many disappointments with regard to the predictive capacity of futures studies.

A second argument for scepticism about the hopes that the above-mentioned problem could be overcome by more research originates from a well-known epistemological consideration. The communication of societal futures is an *intervention* into further development and changes the constellation for which it was created. Thinking about the future is not possible from a contemplative observer's perspective; the producers of knowledge about the future are part of the system for which they construct futures. Here the familiar problem of "self-fulfilling" and "self-destroying prophecy" ties in [18].

So the diversity of futures studies might be reducible in particular areas, in particular when reliable causal or statistical knowledge is available which, of course, varies from field to field. However, diversity cannot be eliminated in general. The diversity of futures is a necessary aspect of many of the fields of futures studies; of course the degree varies in the different fields. So we come to the conclusion that mode 1 orientation often will not be possible. And I would like to add: it is very probable that mode 1 orientation will not work for the particularly interesting topics, those fields with the largest openness and uncertainty, with the biggest need for scientific orientation, reduction of uncertainties and clear orientations. To put it in a paradox way: right there where futures studies are most needed they are most unable to help in the framework of first-order orientation. To compare it with the weather forecast: if weather conditions are stable, the advice of the weather forecast is reliable, but also superfluous. It is most difficult when

the weather conditions are unstable and unclear – and this is exactly when we would need it most. In the following I would like to ask which sort of orientation by futures studies would be possible for those "difficult cases" in the absence of mode 1 orientation.

The value of diversity – mode 2 orientation

So far it turned out that, first of all, mode 1 orientation by futures studies is only possible if the results of the futures studies converge to a "sufficient" amount.[2] In the second place we noticed that this condition is not fulfilled in important societal fields of action and we are instead confronted with a considerable diversity of the results of futures studies. Third, it was briefly discussed that this situation cannot be overcome in general, even with more research, due to the internal structure and premises of futures studies. In this way, the diversity of statements about the future has so far only been addressed from a negative point of view: as a *threat* to the wish for orientation. The expectation of direct (mode 1) orientation in the sense of "deriving" reasonable or even optimal strategies for action from futures studies (see Section 2) is often destroyed by its irreducible diversity. In the following, we will only consider the case of significant diversity to analyse if and how orientation by futures studies can be provided in another mode.[3]

The field of energy futures provides an illustrative example. In the field of energy futures and related emission scenarios we can find various degrees of diversity. For decades incompatible and diverging energy futures have been discussed without exact knowledge on which futures are to which extent backed by knowledge, where the areas of consensus are and where the futures are determined by assumptions on boundary conditions and societal developments which are poorly or not at all verified. The diversity of energy futures is significant: we are not talking about things like error bars to illustrate the discrepancies among them but about divergences of factors of two to four, both regarding the expected total energy need in 2050 and its expected distribution between different energy carriers [20, 21; see also Fig. 1]. According to this, the opinions on the "right" decisions differ as well, and the mode 1 orientation mode does not seem really helpful.

Perceptions of the diversity of the results of futures studies are often presented in a lamenting, regretting tone. "Unfortunately" future developments were so difficult to predict that it would become doubtful whether it is possible at all to draw lessons for today's governance. However, as it has been shown above, this diversity is *necessarily* linked to the preparation of futures studies, even though the extent varies in different fields. But there is no sense in complaining about something intrinsically necessary. On the contrary, we have to ask constructively if there could not be other, rather indirect ways of orientation in these cases apart from mode 1 orientation. Accordingly, a mode 2 orientation by futures studies would have to operate constructively ab initio with the diversity of futures studies and is probably even in need of them. Diversity could then be a *positive aspect*. What we need here is a radically changed perspective which faces the prevalent concern that the diversity of futures impedes orientation.

This has successfully been done in the field of futures studies, differentiating between forecasts and foresight [5–7]. While forecasting corresponds to the mode 1 approach in my classification foresight aims at a broader and more explorative view on futures acknowledging their necessary diversity. Frequently, foresight ends up in a set of scenarios, e.g. for the energy system, for regional development, or for the possible future development of economic branches. Conclusions from those diverse futures are often drawn in form of "robust" action strategies, .i.e. strategies which are promising in all of the possible futures considered [22, 23]. If, for example, we want to phrase strategies for action for sustainable development which should *not* be linked to one single future scenario but geared to a bundle of different futures and suggest positive sustainability effects, this contributes to a "robust" action in terms of sustainability governance (e.g. [4]).

In order to achieve this type of orientation, the value of the diversity of futures studies becomes clear. It is a value because it is correlated with the, at least partly, openness of the future and recalls it to the mind time and again. The diversity of futures studies is a permanent *memento*, reminding us to sound out the possibilities of shaping instead of rashly assuming determinisms and following putative factual constraints which are often only an expression of technocratic thinking or specific interests. The variety of futures corresponds to thinking in options for actions instead of closing into the direction of "optimal" decisions as is done in the line of thought of the mode 1 approach. Furthermore, the question "where are we heading", which is commonly asked in the mode 1 approach, is complemented with the question where we *should* be heading then. The predicative view of future is supplemented with, and maybe sometimes even replaced by, a normative point of view of volition, non-volition or ought. We do not just "derive" from futures how we should act; it is necessary to form opinions and take decisions about volitional and non-volitional issues. Exactly this opens up possibilities to use the

[2] What is meant here by "sufficient", which criteria could be developed for this and how the fulfilment of this condition can be checked needs a separate analysis and is not subject of this paper.

[3] The above-mentioned condition of "sufficient" convergence is at least partly fulfilled in many fields. Future analyses for demographic development for example show discrepancies and divergences in detail, but compared with the divergences in the energy sector they are markedly small. So mode 1 orientation will entirely be possible in particular fields.

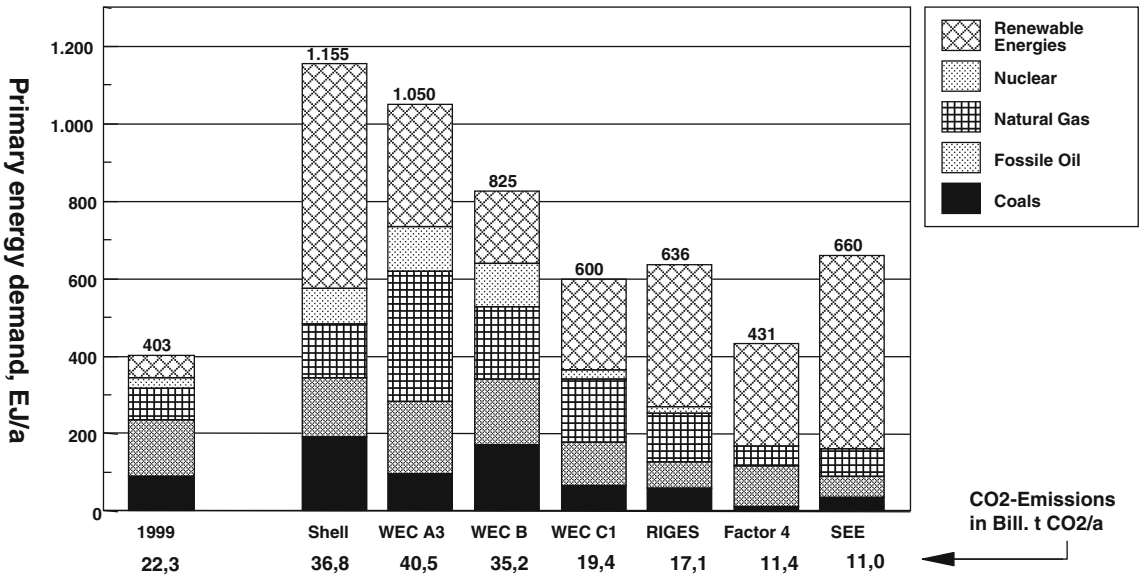

Fig. 1 Some scenarios for the energy demand of the year 2050 assuming a World population of 9.5 billion: Shell-Scenario „Sustainable Development"; three Scenarios of the Energy World Conferences WEC A3, WEC B and WEC C1; RIGES („Renewable Intensive Global Energy Scenario"); Factor 4 Scenario and SEE („Solar Energy Economy"). Source: modified after [19]). Though the scenarios presented are now about ten years old the picture impressively describes the high diversity of energy futures

diversity of futures constructively for democratic debate [24] and to avoid technocratic closure of the future.

Of course the use of diverse futures studies for orientation purposes is not without presuppositions. The precondition for providing mode 2 orientation in the aforementioned sense is that the diversity of the set of futures considered is limited in some sense. There must be a corridor of sensible assumptions about future developments: within the corridor several future developments are regarded plausible but the field beyond the corridor is not considered seriously because of certain arguments. For example, in the field of energy scenarios there is high diversity (see Fig. 1) but not arbitrariness because extreme scenarios are rendered implausible. It is exactly this precondition of relying to a corridor of plausible futures which limits the applicability of the mode 2 approach – and provides motivation to look beyond.

The value of divergence – mode 3 orientation

The necessary precondition of mode 2 orientation to be applicable is the existence of well-argued corridors of the envisaged future development. Frequently, those corridors are mirrored in sets of scenarios where best-case and worst-case scenarios serve as the borderlines of "sensible" future developments. But what could be done if this precondition is not fulfilled, that means if there are no such borderlines, or if proposed ones are heavily contested? If proposed future developments would be not only diverse but absolutely divergent the suspicion of arbitrariness arises. Neither mode 1 nor mode 2 orientation would then be possible because of the laws of logics: no sensible output can be concluded from contradicting or arbitrary input.

There are fields of futures reflection where the impossibility to apply the mode 1 or mode 2 approach clearly became apparent. In the past decade, there has been a considerable increase in visionary communication on future technologies and their impacts on society. In particular, this has been and still is the case in the fields of nanotechnology [17], human enhancement and the converging technologies [10, 25], synthetic biology and climate engineering. Visionary scientists and science managers have put forward far-ranging visions which have been disseminated by mass media and discussed in science and the humanities. The emergence of this new wave of visionary and futuristic communication [26] has provoked renewed interest in the role played by imagined visions of the future. These futuristic visions refer to a more distant future, some decades ahead, and exhibit revolutionary aspects in terms of technology and in terms of culture, human behaviour, individual and social issues. They address possible future scenarios for techno-visionary sciences and their impacts on society at a very early stage in their scientific and technological development. As a rule, little if any knowledge is available about how the respective technology is likely to develop, about the products which such development may spawn and about the potential impact of using such products. High degrees of uncertainty are thus involved leading to severe controversies with regard not only to societal issues but also to the feasibility of the visionary technologies. Furthermore, images of the future range from paradise-like expectations to apocalyptic fears without a possibility to rank the pro an con arguments in a clear way. In spite of lack of

knowledge lively debates on these visionary technologies emerged – and obviously, this field of futures reflections is beyond the scope of the mode 2 approach.[4]

In such cases beyond the mode 2 approach knowledge about the future could be used arbitrarily by representatives of political-societal positions, substantial values and specific interests to enforce their particular positions [3]. In this way knowledge about the future would not orient pending decisions but could only subsequently legitimise decisions already taken. This could be quite rightly called an ideological use of images of the future.

In this Section 1 will develop the thesis that even in this seemingly disastrous situation orientation-building by analysing futures is possible. However, the corresponding mode 3 approach describes a completely different mechanism of providing orientation compared to what we normally expect from futures studies and which is expressed by mode 1 and mode 2 approaches. The only orientation they can provide given the irreducible divergence is a semantic and hermeneutic structuring of a basically open future to allow a better informed and reflected debate for preparing decision-making. It is a matter of reflexive clarification of the conditions under which people can act and decide today, taking into account divergent future perspectives. So mode 3 orientation can only be understood as an offer to improve the conditions of an open, transparent and democratic deliberation and negotiation. The above-mentioned "rational choice" model cannot be used here at all. Instead we are talking about another mode of governance of closing and deciding to which I would like to refer as "deliberative choice".

In this mode, divergence of futures is not a threat but a necessary condition for orientation considering the basically open future which cannot be limited to convergent pictures. Here it is constitutively the democratic dialogue in which it has to be conferred and decided on the respective next steps – in the light of the simultaneous openness of the future and pending needs for decision-making. And especially here, in situations of general openness, this dialogue is of vital significance to a deliberative democracy [24]. Mode 3 orientation asks for the possibilities to orient this democratic conflict by diverse and probably strongly divergent statements – a task which seems to be almost paradoxical.

To trace the possibility of such mode 3 orientation, it is necessary to reveal the reasons for and sources of divergence of futures. What is crucial here is the diagnosis of an "immanence of the present" in which futures studies and reflections are trapped as well [17, 21]. Visions of the future are social constructs, created and "manufactured" by people, groups and organisations at respectively determined points in time [26]. Visions of the future result from a composition of ingredients in certain processes (e.g. the methods of futures research). In this way the respective current knowledge bases, but also contemporary diagnoses, values and other forms of perception of the world are adopted in these pictures of the future. Divergence of visions of the future is, as briefly mentioned above, the result of the consideration of controversial and divergent knowledge bases and disputed values during their creation: the divergence of futures mirrors the differences of contemporary positions and reflects today's pluralism. Thus, uncovering these sources of the diverging futures could tell us something about ourselves and today's society.

So in those cases where mode 1 orientation does not work out and even mode 2 orientation cannot be provided because no corridor of future developments can be identified consensually, pictures of the future hardly tell us about futures in the sense of a present in the time to come, but rather *about us today*. By analysing and reflecting futures studies we can also learn something about ourselves – which would then be mode 3 orientation. If projections of future are interpreted in a way that makes clear why we aggregate certain current ingredients to specific futures and argue dedicatedly about them, then we have learned something *explicitly* about ourselves which to date has only been an *implicit* part of societal reality. Futures studies and reflections as a medium of societal debate contain knowledge and assessments which are worth being explicated in order to allow a more transparent democratic debate and deliberation. And then not only the diversity of futures studies but also the divergence of pictures of the future is a value since it reflects the variety of democratically but also scientifically possible positions.

So mode 3 orientation is about trying to learn something about ourselves, our societal practices, subliminal concerns, implicit hopes and fears from the diversity and divergence of futures studies. Of course: first, to this end futures have to be interpreted or even 'deconstructed' accordingly which calls for adequate assessment procedures [29] and for hermeneutic effort [21, 28]. And second: this form of orientation is much more modest than the expectation of being able to virtually derive "right actions" from futures studies (Section 2). In the end, it comprises of nothing more than improving the conditions for democratic debates and future decisions to make them more sophisticated, transparent and open. Its motivation is based on the assumption that we are able to understand ourselves better, our societal debates, scientific positions, the different interests, hopes and fears, the often diverging perceptions and positions of societal actors – even beyond sciences – once we better understand the diversity and divergence of the concepts of the future.

Three modes of orientation – final remarks

In this article we have asked for the different forms of orientation for the governance of modern societies by futures

[4] Exactly this diagnosis was behind the criticisms against a mere "speculative nano-ethics" [27, 28].

studies and reflections. The suggested distinction between mode 1, mode 2 and mode 3 orientation is geared to the question if and to which extent the results of futures studies tend to converge or diverge. If they are sufficiently convergent, I refer to mode 1 orientation which is also assumed by the popular decision-theoretical model. Statements about the future are interpreted as a framework into which decisions and actions have to fit as good as possible. According to a common phrase decisions and actions are "derived" from knowledge about the future (Section 2).

Of course this model works rather bad or not at all in many contexts since the required convergence of results of the futures studies is not given. The field of energy scenarios has often been used as example. The mode 2 orientation refers to this case relying on the premise that the futures provided do not converge but also not diverge completely. Instead, in this case there have to be good reasons to assume a "corridor" of sensible futures limiting the total openness. In this case orientation to decision-making is possible by looking for "robust" strategies of action promising in several futures within the corridor identified (Section 3).

For the remaining case – completely diverging futures as was and is the case in some new and emerging technologies such as nanotechnology and human enhancement – it seems impossible to derive some orientation because it is logically impossible to derive any sensible output from contradicting or arbitrary inputs. The main outcome of this article is the phrasing of an argumentation which recognises futures studies and reflections also in this case as suitable to give orientation – however, in a completely different mode 3 orientation (Section 4). The orientation given then does not cover the recognition of future developments but the hermeneutics of the present, where we can learn about ourselves from the variety and divergence of statements about the future. This requires splitting the statements about the future into their argumentative structure which in turn offers possibilities to hold democratic debates about the future in a more reflected and transparently enlightened way.

For summarizing these results we refer to Table 1 in the Introduction.

The analysis provided above allows for giving some conclusions and recommendations for the further development of futures studies and reflections:

- the distinction between deterministic and influenceable aspects of the future (Section 2) should be reflected in-depth including a categorization of the respective arguments and a consideration of the influence of determining the borderline between the two parts of the future on the results of future studies:
- the "derivation" of futures from present knowledge (including also other elements such as values and ad-hoc assumptions) and the "derivation" of the "right" decision from converging future projections (Section 2) also should be made subject to reflection about the logical and epistemological status of the "derivation"
- key to the proposed distinction between mode 1, mode 2 and mode 3 orientation by futures studies is whether they show "sufficient" convergence or "strong divergence" - however, between convergence and divergence there is a continuum which should be made subject to further investigation
- anyway: already to apply the suggested distinction to a set of futures needs an assessment procedure; making sense of the diversity and divergence of the results of future studies also needs procedures of analysis and assessment – methodological work is needed in several respects

The overall conclusion is that further improving the scientific quality of futures studies does not generally mean strengthening their predictive capacity (this only might be the case in specific fields) but rather working toward a better understanding of the relations between future studies, the provision of orientation and making use of the orientation provided in decision-making [30].

References

1. Beck U (1992) Risk Society: Towards a New Modernity. Sage, London
2. Grunwald A (2009) Technology Assessment: Concepts and Methods. In: Meijers A (ed) Philosophy of Technology and Engineering Sciences. Elsevier, Amsterdam, pp 1103–1146
3. Brown N, Rappert B, Webster A (eds) (2000) Contested Futures. A sociology of prospective techno-science. Ashgate, Burlington
4. Voss JP, Bauknecht D, Kemp R (eds) Reflexive Governance for Sustainable Development. Edward Elgar, Cheltenham
5. Rescher N (1998) Predicting the Future. An Introduction to the Theory of Forecasting. Suny Press
6. Bell W (1997) The Foundations of Futures Studies.
7. Slaughter R (2005) The Knowledge Base of Futures studies.
8. Luhmann N (1997) Die Gesellschaft der Gesellschaft. Suhrkamp, Frankfurt
9. Grunwald A (2007) Working Towards Sustainable Development in the Face of Uncertainty and Incomplete Knowledge. Journal of Environmental Policy & Planning 9:245–262
10. Grunwald A (2007) Converging technologies: Visions, increased contingencies of the conditio humana, and search for orientation. Futures 39(2007):380–392
11. Slaughter RA (1995) The Foresight Principle: Cultural Recovery in the 21st Century. Adamantine Press, Ltd., London, England
12. Hempel CG (1965) Aspects of Scientific Explanation and other Essays in the Philosophy of Science. Sage, New York/London
13. Renn O (1996) Kann man die technische Zukunft voraussagen? In: Pinkau K, Stahlberg C (eds) Technologiepolitik in demokratischen Gesellschaften. Metzler, Stuttgart, pp 23–51
14. Grunwald A (2007) Technikdeterminismus oder Sozialdeterminismus. In: Dolata U, Werle R (eds) Gesellschaft und die Macht der Technik.

Sozioökonomischer und institutioneller Wandel durch Technisierung. Campus, Frankfurt/New York, pp 63–82
15. Goodman N (1954) Fact Fiction Forecast. Harvard University Press, Cambridge
16. Knapp HG (1978) Logik der Prognose. Alber, Freiburg/München
17. Grunwald A (2006) Nanotechnologie als Chiffre der Zukunft. In: Nordmann A, Schummer J, Schwarz A (eds) Nanotechnologien im Kontext. Akademische Verlagsgesellschaft, Berlin, pp 49–80
18. Merton R (1948) The Self-Fulfilling Prophecy. The Antioch Review 8(2):193–210
19. Nitsch, J., Rösch, C., Perspektiven für die Nutzung regenerativer Energie. In: Grunwald, A. et al. (ed.), Forschungswerkstatt Nachhaltigkeit. Berlin, 2002, 291–323.
20. Keles D, Möst D (2011) Fichtner W (2011) The development of the German energy market until 2030 – A critical survey of selected scenarios. Energy Policy 39:812–825
21. Grunwald A (2011) Energy futures: Diversity and the need for assessment. Futures 43(2011):820–830
22. Bishop P, Hines A (2006) Thinking about the Future: Guidelines for Strategic Foresight. Social Technologies, Washington, DC
23. Lindgren M, Bandhold H (2003) Scenario Planning-the link between future and strategy. Palgrave Macmillan, Hampshire and New York
24. Habermas J (1992) Drei normative Modelle der Demokratie: Zum Begriff deliberativer Politik. In: Münkler H (ed) Die Chancen der Freiheit. Beck, München, pp 11–124
25. Roco MC, Bainbridge WS (eds.) (2002) Converging Technologies for Improving Human Performance. Arlington
26. Selin C (2007) Expectations and the Emergence of Nanotechnology. Science, Technology and Human Values 32(2):196–220
27. Nordmann A (2007) If and Then: A Critique of Speculative NanoEthics. Nanoethics 1:31–46
28. Grunwald A (2010) From Speculative Nanoethics to Explorative Philosophy of Nanotechnology. NanoEthics 4:91–101
29. Pereira AG, von Schomberg R (2007) Funtowicz S (2007) Foresight Knowledge Assessment. International Journal on Foresight and Innovation Policy 3:53–75
30. Barben D (2008) Anticipatory Governance of Nanotechnology: Foresight, Engagement, and Integration. In: Hackett EJ, Amsterdamska O, Lynch ME, Wajcman J (eds.) Handbook of Science and Technology Studies, MIT Press, 979–1000