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Sustainability-related Knowledge Communication between Strategic Staging, Information, and Understanding

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Abstract: In view of societal processes of sustainability-related exchange processes, the communicative interplay between individual citizen and society, inseparably linked to intermediary levels of mutual conciliation, is essential. In this regard, science faces the challenge to deliver policy- and action-relevant knowledge for decision making. Thus, the design of communicative interfaces between science, politics and the public is of particular significance, given the fact that a sustainable society without social communication on sustainability seems to be clearly out of reach.

This paper is intended to present a retrospective on knowledge-based research within the environmental discourse. It is shown that these approaches do not only allow for deepened analyses and substantial optimization of stored knowledge but, furthermore, also highlight opportunities for various contexts of sustainability-oriented governance. Subsequently, these approaches are critiqued within the context of knowledge communication and analyzed in the light of the contrasting "internal rationalities" of science and politics. In doing so, trends in medialization in both domains are taken as much into account as participative practices for including non-scientific actors in political decision-making.

With regard to the individual level of knowledge communication, the ipsative theory of action is considered as a helpful pattern of thought as it adverts to effective selectivity between objective conditions of situational action and its subjective counterpart. These individually-based principles are reflected on key aspects of knowledge communication and

analyzed in the light of contrasting "internal rationalities" of science and politics. In doing so, trends for participative practices for including non-scientific actors in political decision-making are taken into account. As a result, various dimensions of a dialogically-reflexive communication are proposed against the backdrop of future societal pathways towards sustainability, reflecting the diversity, dynamics and self-organization – all featuring the liaison between science and politics both organizationally and on an individual basis.

Keywords: sustainability communication; knowledge communication; medialization of science; interface management

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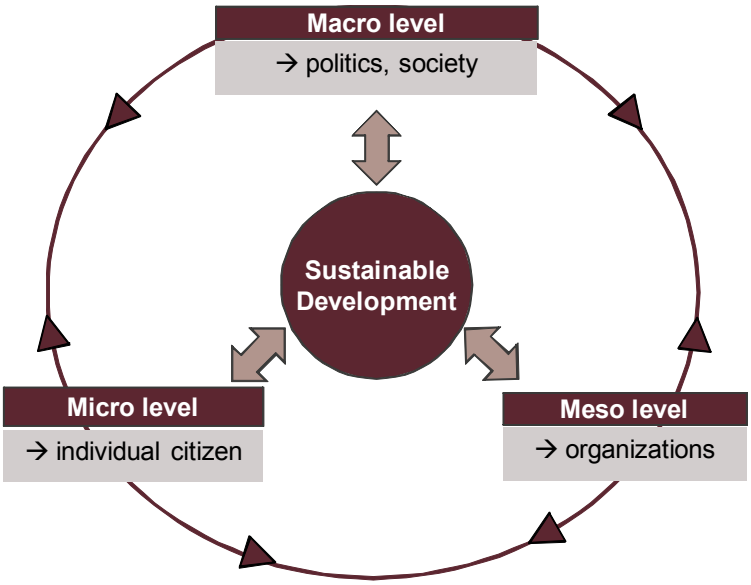
1. Introduction

When considering environmental understanding processes, it is instructive to concentrate on the interplay between the individual and society together with all of the intermediary agencies involved in sustainable development. After all realizing this vision is at its core about improving society's – at all of its levels and in its ecological but also economic and especially in its social and cultural dimensions – capacity to learn and so to act. Thus at the individual level the focus is on the development of new knowledge and new competences that will enable an individual person to act in a sustainable way. In contrast, at the meso-level (which includes educational and research institutions as well as industry and trade associations or political parties) the focus is on setting new priorities and continually improving the quality and performance of sustainability-relevant structures. And finally on the macro-level new agendas need to be created and, with the help of innovative partnerships and together with new ways of interaction, participation and partnership, practically implemented (Goldstein, 2005).

Science plays a crucial role in orienting society towards a sustainable development. In the realm of science ways to possible futures can first be theoretically developed and then tested as to their practicality in cooperative and participative research projects. At the same time there are growing demands on science to provide knowledge relevant for political decision-making and action. Science can therefore only achieve its transformative potential – namely making the vision of sustainability an integral part of social development – if it acts in accordance with relevant cultural change processes in society as a whole.

The ultimate goal is a learning society that in co-evolutionary interaction between the individual and organization develops towards sustainability (Fig. 1). The shaping of communicative interfaces between science, politics and the public thus takes on particular importance, as only when there is societal communication about sustainability – this is the core thesis of the considerations elaborated below – can there be a sustainable society.

Figure 1. Communication of knowledge for sustainable development: coevolutionary interaction in a multi-level system; Source: own elaboration



2. Methods

Concerning the structure of this paper: in order to pursue the question of what role knowledge and science communication are able to play in the context of environmental management and advisory processes, it might be advantageous to first take a brief retrospective look at the research into knowledge processes within environmental discourse. It will be argued that several operationalisation approaches developed in the environmental social sciences share a number of common characteristics making them also relevant in the context studied in this paper. For instance, aspects of control, or at least of how bodies of knowledge can be influenced and optimized, are also at the center of attempts in the social sciences to operationalize environmentally relevant knowledge. Such an investigation would thus be able to reveal the constitutive relationships in the most recent debates about control, such as governance approaches.

In the main part of this paper, central aspects of knowledge communication are examined and then developed using the "inner rationalities" of science and politics. This includes studying the medialization tendencies of both domains and outlining communicative ways of involving non-scientific practitioner-actors in political decision-making processes. In order to account for the diversity, dynamism and self-organization that characterizes the exchange between science and politics, a number of key parameters of a dialogic-critical interface communication will be proposed. Finally, an attempt is made to assess the importance of transdisciplinary communication and knowledge production for future attempts to move sustainability forward.

3. Results and Discussion

3.1. Environmentally relevant knowledge – an outline of typing approaches in (environmental) social sciences

In the various disciplines of environmental (social) sciences, a number of approaches can be found that attempt to operationalize the term 'knowledge'. A comparison of these conceptualizations reveals that a principle motivation of such approaches consists of relating knowledge more or less directly to an aspect considered to be crucial (Gysin, 1989; Stenger, 1990; Fritsch, 1991; Kuckartz, 1994; Eden, 1998; Bögeholz, 1999; Gräsel, 1999b).[1]

Fuhrer and Wölfing discriminate between two types of knowledge – factual and procedural knowledge – which in a cognitive perspective can be seen as 'knowing' and 'understanding relationships' in defined parts of the world:

> For environmental knowledge, factual knowledge is the precise knowledge of environmental problems and of cause and effect in environmental contexts (e.g. the knowledge that CO2 emissions contribute to the greenhouse effect), while procedural knowledge includes knowledge about how to solve a problem (e.g. the knowledge that ozone levels can be reduced by restricting individual use of automobiles). (Fuhrer & Wölfing, 1996, p. 548)

At the same time, Fuhrer and Wölfing criticize the lack of a clear distinction among the current understandings of the term 'knowledge' in environmental awareness research. They concede that often environmental knowledge is understood as factual knowledge, which is equated with the knowledge of abstract cause-effect relationships.

In a meta-study of current environmental awareness research, de Haan and Kuckartz find environmental knowledge to be a constitutive element of environmental awareness and distinguish this from environmental attitudes and environmental behavior:

> Environmental knowledge is understood to be the degree of knowledge and information a person has about nature, about trends and developments in ecological attention fields, about methods, patterns of thinking and traditions relating to environmental issues (de Haan & Kuckartz, 1996, p. 37)

Subsequently, a series of similar studies on the central issue of differentiation were published, often focusing on the relationship between cognition and behavior (Kaiser & Fuhrer, 2000; Rieß, 2003). Such approaches include for example attempts to develop a genuinely action oriented level and to clearly distinguish it from the aspects of environmental factual knowledge and knowledge about causal relationships. Then these types of knowledge constitute, as argued by Preisendörfer and Franzen with reference to the results of a large number of empirical studies (cf. Diekmann & Preisendörfer, 1998), a dimension that is comparatively removed from an action orientation:

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[1] Knowledge in this sense is equivalent to the capacity to act, on an individual level, but with a view to "cosmopolitan ability to act" (Stehr, 2003: 259; cf. Stehr, 2005).

> Environmental knowledge can be divided into factual knowledge, knowledge about causal relationships and knowledge about individual and general possibilities to take action (…). (Preisendörfer & Franzen, 1996, p. 225)

The mismatch often conceded between environmental knowledge and its influence on ecological behavior is investigated by Frick (2003) in her dissertation. Based on her own empirical studies with extensive sample sizes, she is able to, with the use of a measuring instrument she has developed herself, to convincingly differentiate the methodological and substantive elements of the knowledge concept in a number of sub-forms. Thus in a representative survey of the German-speaking Swiss population (N=2,736) it was shown that, although systemic knowledge is considered a basis for knowledge about action and effectiveness in an ecological context, it does not however itself have a demonstrable effect on ecological behavior. For these two types of knowledge however a direct effect on behavior was detectable. In a further study (N=270) Frick examined the indirect influence of knowledge on behavior. She notes that "the influence on behavior of knowledge about action is mediated (…) by self-efficacy expectations and intention, as is that of knowledge about effectiveness by environmentally relevant attitudes and intention" (Frick, 2003: 106). Based on her findings, Frick proposes a model for the integration of environmental knowledge in an adapted version of the theory of planned behavior (ibid., 113, 118).

Ultimately, she favors a more strongly subjectivist orientation, which had already been proposed by other researchers, as can be seen in the following section.

Contours of a subjectivist "epistemic turn"?

A number of years ago in an attempt to determine the importance of knowledge in research on environmental education, Gräsel had already argued that greater attention should be paid to individual concepts and subjective theories instead of a broader objective concept of knowledge. She criticizes that often in objective approaches only the degree to which the representations of the respondents correspond to those of the test constructors is measured, which then makes them 'correct'. As a result it is important to conduct empirical studies of individual representations "in order to be able to make real statements about the relationship between knowledge and action" (Gräsel, 1999a, p. 185).

While Gräsel develops desiderata and perspectives for what she considers to be practicable ways to research knowledge in the context of environmental education, and so seems to remain on a more programmatic level, Tanner and Foppa (1996) had some years earlier attempted to resolve exactly this contradiction between objective and subjective perspectives.

Their idea of an ipsative theory of action is given more detailed consideration in the following section, as it has two interesting approaches in regard to the importance of knowledge for environmentally relevant action and its consequences. First, these ideas recur in lifeworld contexts and identify their knowledge-related meanings. Additionally, and to an extent as a necessary consequence, these considerations are grounded in the epistemological building blocks of a constructivism, showing its importance as a theoretical reference point in this paper.

A digression in the knowledge dimension of ipsative[2] action theory

Based on a critical summary of the most important theoretical and methodological problems in environmental research, Tanner and Foppa advance the thesis that more attention should be paid to potential restrictions on action, the perception and evaluation of environmental changes as well as the perception of the consequences of action. Regarding the cognitive aspects of environmentally relevant action, they argue that research should be less preoccupied with objective restrictions. In their analysis, they concentrate on three major issues they believe are important for human cognition and action: the role of personal perception and evaluation of environmental problems and risks, accounting for restrictions on the scope for action as well as the problem of the perception and evaluation of the consequences of action. For these areas of environmental awareness research, according to Tanner and Foppa, there is a serious discrepancy between the objective situation regarding the environment and subjective evaluation and stress reactions (ibid., 245).

Tanner and Foppa distinguish between an "objective realm of possibilities", defined as the number of objectively available alternatives to take action, and an "ipsative scope of action", defined as the "options that actually come 'to mind' in the moment an individual makes a decision" (ibid., 246). This concept does not however simply refer to restrictions on possibilities to take action, as researched in differential psychology, for example due to personal deficits such as inabilities, etc. On the contrary, an ipsative theory of action goes beyond accounting for external restrictions on action and its consequences by focusing on ipsative restrictions on the actions of an individual. This means that actions are not initially prevented by external restrictions (e.g. limited amount of time); instead they are prevented by an alternative course of action "not coming to mind" for the acting individual in the decisive moment[3].

With reference to the role of knowledge in such processes, it is important to note that this reduction of the options being considered is not the result of "a marginal evaluation process" but instead it is "the uncritical result of individual preferences, dislikes and habits". The (moderate) constructivist background of this line of thought becomes apparent in the following:

> On the one hand, ipsative restrictions can be traced back from individual experiences of the "world" and on the other they are the result of an individual social biography. (…) The recording of the options considered by an individual as preparation for taking action is of necessity obstrusive. That is, each attempt to learn from an individual which alternatives he or she is considering inevitably leads to the possibility (but not the necessity) of a change in these possibilities. (ibid., 246; emphasis in the original).

Tanner and Foppa point out how for a number of other researchers from different disciplines – especially psychology and sociology (Fietkau & Kessel, 1981; Preuss, 1991; Diekmann & Jaeger, 1996; Schahn & Giesinger, 1993; Kaufmann-Hayoz et al., 1996) – the perspective of restrictions on

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[2] The expression ipsative (from lat. "ipse" = self) is coined by Foppa and Frey (1986) to make clear the difference to "subjective" theories (cf. Frey & Heggli, 1989; Frey, 1988; Foppa, 1988).

[3] Since the ipsative perspective is not only relevant for the phase before an action, but also for the following ones, Tanner and Foppa speak of an equivalent "ipsative consequence space", in which those consequences that an individual is not aware of before carrying out an action are not given a control function (ibid., 247).

action has proved to be empirically fertile, especially in psychological studies of ecological and environmentally relevant action (context-independent characteristics of perception situations, e.g. discriminative stimuli, but also concerning attitudes towards environmental problems, cognitive representations of environmental changes and their meaning).

Tanner and Foppa attempt to forestall possible criticism of their theory by raising the question of how their explanation – according to which ipsative options to take action and their consequences become uncritically, i.e. not based on marginal evaluation processes, salient – can be reconciled with explanations that are based on rational choices between alternatives. With a large number of empirically validated findings "from a number of fields of descriptive psychological research" (1996, p. 246), Tanner and Foppa argue that their own approach is better than "more rational" ones (e.g. rational choice, expectancy value theory in motivation and action psychology; cf. Liebe & Preisendörfer, 2010). When decisions must be taken, they point out, individuals are oriented much more strongly towards a number of "pragmatic" heuristics than towards objective situations. In addition, they are more strongly influenced by locus of control than by subjective probabilities and they use information only very selectively; especially in complex decision situations individuals do not behave "rationally" (in a theoretical sense), because they eliminate information and simplify decision-making problems. With reference to decision-making processes in lifeworld reality they explain:

> Furthermore, the occurrence of "real" decision situations, which require the individual to consciously choose between at least two alternatives, should not be overestimated in *everyday action*. For example, *routine actions* are characterized by not taking other, alternative options "into consideration". The individual follows *automated behavioral schemata* without thinking about the pros and cons of alternatives (ibid., 248; emphasis added)

This leads Tanner and Foppa to conclude that caution should be taken in regards to normative decision-making approaches and instead work should concentrate on developing realistic models of decision-making and action processes. However they do not provide any suggestions as to how these models could yield specific research questions. Although as part of a small explorative study Tanner and Foppa have been able to demonstrate with the help of a method based on constructivist theory that subjective knowledge does indeed play a role, they admit to not having an answer as to how subjective evaluations are related to the activating of ipsative options to take action (ibid., 259).

What conclusion can be drawn from this digression? It is probably fair to say that the cognitive value of ipsative action theory lies in its contribution to discriminating between the objective reality of situative action and its subjective counterpart. Critically, however it should be pointed out that in the following years, with the exception of several papers by Tanner (1998, 1999, 2006) there was little interest in this approach, even by the Tanner and Foppa themselves.

An important reason for that could be that at almost the same time mono-causal models were largely being replaced by more complex analytical approaches. This hypothesis is supported by for example the growing popularity in the mid-90s of lifestyle-based research approaches, in which however knowledge is given less importance than value orientations (cf. Kleinhückelkotten, 2005; Degenhardt, 2007). These also form a bridge to sustainability discourse, and so to the origins of sustainability sciences as well as similarly connotated conceptualizations of knowledge, as discussed in the next section.

3.2. Knowledge communication as a constitutive element of social sites of negotiation

In the context of polyphonic discussions about the phenomenon of a knowledge society[4], in whatever form it might take, Tanner and Foppa largely agree that a reevaluation of knowledge has taken place. This can be seen in the increased interest shown how people participate in knowledge – whether it is participation in the production of knowledge or in its acquisition (Nowotny et al., 2001; Jasanoff, 2006; Böschen, 2007). The fact that knowledge is no longer considered relevant in regard to particular goals, but instead represents a social value in itself (cf. Unesco, 2005; European Commission; 2007), which as a matter of course diffuses into everyday life, has led some authors to conclude that knowledge is a "major category" that does not permit any differences to be made between everyday and scientific knowledge; as a result the world is from now on to be understood as "a world of knowledge" (Weingart, 2005, p. 151; Winkler, 2006, p. 27).

Knowledge communication between science and politics

Nevertheless a society cannot avoid making decisions about which direction it would prefer development to take. In political decision-making, collective agreement about possible future options are made under conditions of uncertainty, which alongside knowledge about ends-means relationships also involves preferences about those ends and means (Pellizzoni, 2010). The conflicts that then arise in complex societies are mainly the result of the increasing diversity of social actors on the one hand and the need for an "integrative logic of control by the community" on the political side (Renn, 2007, p. 161). An example of the differences in such "interior rationalities" can be seen in the interrelationship of politics and science (cf. Braun & Kropp, 2010).

The problems in knowledge communication can be briefly listed below (cf. Nieberg, 2007; Heinrichs et al., 2007; Neidhardt et al., 2008; Feindt et al., 2007; Weingart, 2005):

- Different time horizons: Science often has a longer term perspective, while politics more often deals with urgent problems.
- Different interests in knowledge: There is a potential conflict between the pursuit of motiveless scientific knowledge (i.e. not primarily oriented towards a social setting) and the user or problem-related orientation of political action.
- Different results: Closely related to the prior point, abstract and ambiguous results in science are diametrically opposed to the simplified knowledge desired in politics.
- Different relationship to the public: While in science-generated knowledge is considered "unripe" and thus needs to be made available to further (public) scientific control processes, in political decision-making confidentiality plays an important role.

Further problematic dimensions in interface communication from the perspectives of science and politics are compared in Table 1.

[4] For a comprehensive critique of the term and the concept of knowledge society, see among others Böschen and Schulz-Schaeffer (2003); Bittlingmayer and Bauer (2006); Jäger (2007); Kübler (2005); Tänzler et al. (2006); Knoblauch (2005, p. 255ff.); Weingart (2003, p. 134ff.).

Table 1: Science-related problem dimensions of interface communication from the perspectives of science and politics; Source: Feindt et al. (2007, p. 256), adapted

Problem dimension	**Science perspective**	**Political perspective**
Presentation of knowledge	- Science requires care in selecting methods and interpreting results - Problems of generalizing and prediction - Doubt as 'first cause' of science - Accounting for and involvement in controversy is encouraged - Drive for originality, innovation and excellence	- Knowledge must be authoritative and reliable - Few resources for detailed and thorough involvement with methodological and validity issues - Estimates should be presented convincingly - Extrapolation and prediction are especially desired
Ambivalence of knowledge	- Scientific recommendations can be contradictory - Different scientists offer different solutions - Different schools of thought are formed - Thinking in complexity and contradictions is typical - Not-knowing and ambivalence in evaluation accepted as unavoidable	- Search for knowledge that is as persuasive and unambiguous as possible - Experts prefer the "schools" they belong to; politicians prefer recommendations they are familiar with - The political location affects decision-making behavior regardless of the solution being considered - In case of ambivalence or scientific disputes: choice of acceptable experts and request for biased expert opinions
Fragmentation of knowledge	- Fragmentation and specialization in science - Inter- and transdisciplinarity still rare and difficult to realize - Meeting in committees with different ways of thinking	- Confrontation with complex and dynamic problems - Goal is a comprehensive view of the common good - Different logics in politics and administration
Generalized vs. context-specific knowledge	- Results are often abstract, ambiguous, relativized - Clear results require precise, small-scale questions (which are untypical for political problems)	- Politics requires action-oriented knowledge, simple and easily implemented recipes and strong messages attractive to the media - Questions are often vague and overly complex

Changes in the relationship of science and politics can be generally said to result from both the changing role of science itself and from phenomena outside science (Sales & Fournier, 2007). The latter include the great importance of the media in political communication, which not only entails an orientation of political actors towards the logic of the media, but also exercises an increasing influence on science (cf. Weingart, 1998).

Medialization of science

The process of media's growing importance for society over time is captured by the term medialization (Weingart, 2005, p. 12). The term mediatization is also used as a synonym, referring in the same way to the meta-process of social change permeating all of society from the macro to the meso- and micro-level, even if the attempt is made at times to define the term as "not media generated but media related" change in societal communication (Krotz, 2007, p. 38; emphasis added). This analytical-theoretical distinction is however difficult to ground empirically and thus will not play a role for the relationship being considered here, as ultimately the medialization of science is subjected to the

same conditions of medial communication as are all other forms of communication. This includes the dependence on specific logics of communication, as well as fast-changing levels of interest in or relevance of specific topics (Weingart, 2005, p. 30, 151). Even if the validity criteria in science within science communication cannot be replaced, they are supplemented in public oriented communication by additional criteria. Peters et al. consider as empirical evidence for the medialization of science the high value placed on medial science communication both within organizations as well as for individual scientists, the institutionalization and the attachment of media contacts to leadership roles as well as the "adaptation of communicative self-expression to the logic of the media with the consequence that relevance is constructed with references outside science" (Peters et al., 2008, p. 289).

The question arises as to the power of knowledge. Weingart sees the media as "a kind of fourth power", which by its own means of construction communicates and disseminates topics, creating in science and politics a number of pressures to conform (Weingart, 2005, p. 159). Regarding medial reporting on science, he states that medial prominence is increasingly competing with scientific reputation (ibid., 170). Sensationalization and personalization, both characteristic means of attracting attention by the media, contain however considerable communication risks, especially in disaster topics such as the danger of a permanent undermining of the credibility of science and its institutions.[5]

Conditions for the success of a possible future of "fear communication by science" are, according to Weingart, "when the expectations and assumptions of certainty placed on science as well as its claims to knowledge yield to the insight that uncertainty of knowledge and not-knowing belongs to science as much as certain knowledge, that the discussion and use of uncertain knowledge in decision-making is inevitable and that decisions cannot be legitimated in a single dimension, then science, politics and the media will have taken their place in knowledge society" (ibid., 166).

Concerning science however it is clear that knowledge can hardly ever be without effect, as its mass medial effect makes it an irreplaceable part of the communicative process of social change and self-construction (Winkler, 2006, p. 42). Science affects medialization and is in turn affected by it.

Knowledgeable knowledge between reliability and the demand for accountability

Science may be able to create space and options for thinking about and acting in the future, but increasingly complex causal relationships, which are typical for sustainability problems, have their price. Instead of demonstrable and conclusive truth in a globalizing knowledge society shaken by crises of legitimation and authority, there is often an ambiguous knowledge, lacking epistemological evidence as well as the possibility of being put into practice. As a result of the erosion of the "social contract with science" beginning at end of the 1970s, the once solid arrangement of trust and control has begun to shift (Weingart, 2005, p. 9; Gläser et al., 2008, p. 145). At the same time scientific expertise has developed into an important resource in the search for solutions to political problems.

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[5] The Frankfurter Allgemeine Zeitung for example has, with references to climate change and sustainability, criticized this: "'Climate Change' – a term that is used in every discipline and every language – has now opened the door for scientists to politicians and funding. In many areas the buzzword had become a certificate for responsible science and so a science worthy of funding. Such fashions that have triggered terms such as *'sustainability'* are dangerous. Because under the pressure of supposedly urgent issues, it is easy to lose sight of one's standards." (FAZ, 8.01.1997; emphasis added)

Expert knowledge is not to be compared with scientific knowledge, as it does not involve the search for new knowledge, but instead offers for sale "reworked expertise made relevant for decision-making and future-oriented" (Kropp and Wagner, 2008, p. 191; 2010). Kropp and Wagner distinguish between technical knowledge (knowing-that about facts, processes and indicators), action-oriented knowledge (knowing-how about processes, their conditions and consequences) and an – often implicit – interpretive knowledge (knowing-why), with what is considered useful knowledge varying according to the point of view of the observer. In their analysis of communication at the interface between science and agricultural policy, they found in certain places a "a particular kind of hybrid knowledge about orientation and development", which "occurs in an almost pointillist fashion in a number of context-relevant problem solving concepts, in at times contradictory forms of presentation and different forms of elaboration" (ibid., 175f.). Political expectations are often anticipated by experts when preparing useable knowledge for their clients. Given such "expectations of expectations", academic policy advisors orient their research planning in three different ways, as service providers, concept entrepreneurs or as counter-experts. Such strategic staging of communication by creating a certain political proximity is seen by the Kropp and Wagner as a crucial condition for the successful communication of knowledge. "Topics must be positioned and framed, explanations argued for and defended, expertise with the help of communicative profiling and rhetoric sold." (ibid., 191). For scientists this means losing the possibility of communicating defining features of scientific knowledge such as perspectivity and uncertainty.

With such empirical findings it is not surprising that two recent trends can be observed, one of which is oriented towards science itself and its own quality criteria for scientific knowledge and the other – and directly related – towards discussing its role in the process of social decision-making. The traditional scientific criteria of reliability is still considered as necessary but no longer as sufficient for validating knowledge, since at the same time there are increasing demands in society for a science that meets the requirements of accountability by "examining more closely its own implications and limits" (Wagner & Kropp, 2007, p. 22f.).

In this context, Böschen et al. draw attention to "cultures of not-knowing", which characterize "within science a number of principally equal forms and practices of dealing with not-knowing (Böschen et al., 2008, p. 199; cf. Böschen et al., 2006; Gross, 2007). Such an orientation towards criteria of "accountability of research or responsibilization of (…) researchers" is accompanied by, according to Maasen (2007, p. 221), developments towards social "governance through (self-) control and (self-) attribution of responsibility" of a community that sees itself as an "audit society" (cf. Power, 1997; Gibbons, 1999).

As already suggested, this also involves a relativization of science, which is still indispensable for political decision-making, but, as an evaluation of alternatives for political action cannot be undertaken by scientists and experts alone, it is no longer considered to be sufficient (Renn, 2007, p. 173f.). Accordingly, Weingart's dictum that "in the knowledge society (…) everyone is both an expert and a layperson at the same time" is grounded in the observation that the number of experts and their importance increases to the extent that knowledge – and especially the number and complexity of questions the production of new knowledge initiates – increases. At the same time the number of laypeople increases. "This dynamic of differentiation has shifted the boundary between those who know and those who do not, which once divided science from the rest of society, into science." (Weingart, 2005, p. 51).

Science therefore cannot definitively exonerate politics of responsibility. Instead of scientific advisors in politics "speaking the truth to power", there are increasingly different groups taking part in different ways in a "negotiated model" (Jasanoff, 1990). The dimensions of such sites of negotiation are discussed in the following section.

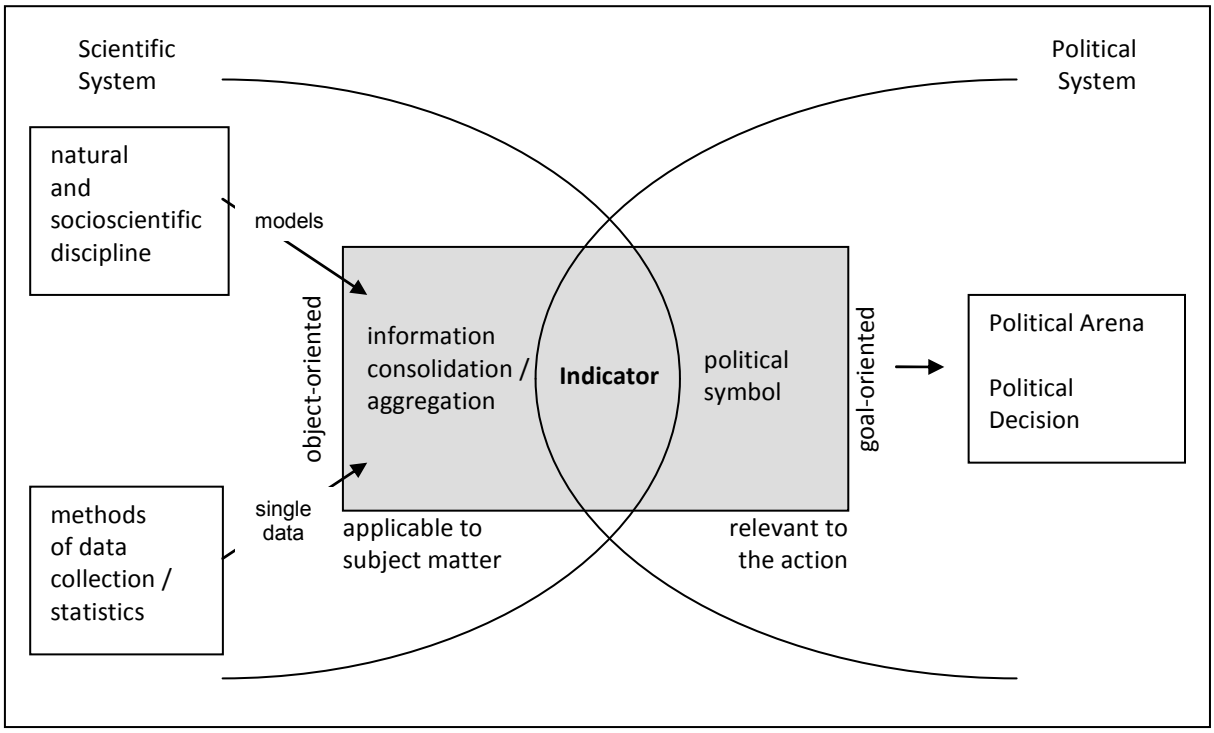
Dimensions of dialogic-critical interface communication

As shown above, communication between science and politics aims at finding ways of situating and integrating knowledge (cf. Maasen and Weingart, 2005). In the creation of social context, without which there could be no implementation or anchoring of knowledge, it is also essential for non-science practitioners to be involved as actors (Feindt et al., 2007, p. 260). Especially in discussions about risk policy, trust building measures are central to the success of sites of negotiation (Weingart, 2005, p. 60; Gläser et al., 2008, p. 145).

By sites of negotiation is meant the "topic-focused intertwining of actor networks and discursive structuring (…) which initiate social search and learning processes and stabilize them institutionally in the tense and conflictual space between politics, science, economics and the public" (Böschen et al., 2008, p. 206). This involves specific areas that are part of a general medial and political public whose essential criteria is the focus on a topic, as this facilitates the bundling of social knowledge resources and allows individual actors to relate their different patterns of perception and strategies of action to each other. The impulse for the development of a site of negotiation is often the result of what is at first a still amorphous topic structure, which however precisely because of its openness offers a variety of possibilities for actors to relate their framing of problems to each other. At the same time sites of negotiation are crucially characterized by conflicts about which bodies of knowledge are relevant (ibid., cf. Lieven & Maasen, 2007).

Especially in search processes within sustainable development, which are characteristically conflicted in their early phases (cf. Figure 2), it is important for actors to be willing to enter into a dialogue that is both anticipative and understanding oriented regarding each other's needs to take action and their interior rationality, as well as the complexity and ambivalence of the problem complexes being negotiated.

Figure 2: Locating (sustainability) indicators between science and politics;
Source: Nieberg (2007, p. 97) following Zieschank (2003); adapted



Creating a dialogic-critical interface communication in the space between science and politics, according to Kropp et al. involves taking the following two dimensions into account:

- Cognitive dimensions: Selectivity and perspectivity of scientific statements need to be seen in the social, technological and methodological contexts that help determine the production of knowledge. Concerning values and interest pluralism, it is important to note that conflicts surrounding different interpretations of the problem are often not about factual matters but about values and interests, which themselves are grounded in the different interior rationalities of politics and science. Knowledge pluralism is on the one hand the ability of "putting things in relation", of putting scientific knowledge in relation to other forms of knowledge (especially local and experiential knowledge), but it is also about recognizing the plurality of the disciplinary formed knowledges with science itself. Moreover the boundaries of knowledge must be explicitly defined – both concerning not-knowing within science as well as its advisory role in providing scientific knowledge to politics. Finally it is about the self-image or identity of science and the question as to who science sees as its beneficiary.
- Processual dimensions: Critical institutions are required that are able to create feedback between science and practice. Dialogization includes a turning away from a decisionistic or arbitrary division of labor between science and politics as well as an opening to expertise from non-science social groups. Successful inter- and transdisciplinarity allows for different degrees of depth and breadth of cooperation with experts. For participative approaches to research, the question is more about which of the four kinds of participation intensity is desirable (contractual, consultative, collaborative or collegial participation), while concerning the point in time it is important to decide whether practitioner-actors are to be involved only in the generation of

research questions, in the critical commentary of results at the end of the project or whether there should be continual participation during the whole research process.

Such procedures of capturing and evaluating knowledge should ideally receive legitimation from the political system, evidence from science and reasonable consideration of value plurality and fairness from civil society. Nevertheless such discursive processes do not automatically lead to consensus, because the result can equally be "consensus about dissensus". Its success is thus measured more on providing greater clarity and not necessarily on creating agreement, increasing the chances for a greater acceptance of the results, even by those who were not able to realize their preferences (Renn, 2007, p. 170).

Finally, successful interface communication is characterized by a strengthening of diversity, dynamism and self-organization, all features of the exchange between science and politics (cf. Truffer, 2007). For political decision-making processes moreover the ability to make science useful, to think and evaluate in alternatives is crucial (Kropp et al., 2008, p. 192). Such a reciprocal willingness to an opening and openness in communication is not overshadowed by the fact that "in contrast to all assumptions of dedifferentiation (…) in substance the scientific [remains] scientific and the political political" (Neidhardt et al., 2008, p. 37).Main text paragraph (M_Text).

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4. Conclusions

In conclusion, an attempt should be made to assess the importance of transdisciplinary communication and knowledge production, outlined as an environmental policy perspective in this paper, for society's efforts to achieve sustainability.

The first thing to note is that the understanding of knowledge argued for above involves making a clear distinction between a traditional concept of knowledge as purely subject and consciousness-centered and knowledge as the (self-) attribution of individuals integrated in particular practices of knowledge production. Knowledge must then always be understood as context-bound, oriented to the natural and social conditions of the human environment and so exercising a decisive influence on practical behavior. This interaction of knowledge and the environment is understood as dynamic; and is subject to communication-related influences just as much as learning processes evoked elsewhere. In the end this understanding includes coevolving transactions between the entities involved, thus overcoming dualistic schematizations of knowledge that – for example in the contrasting of everyday knowledge and scientific knowledge – insinuate reciprocally exclusive polarities and so negate transdisciplinary processes of knowledge generation.

This reciprocal interpenetration of science and society, which is characteristic of knowledge societies, leads to seeing individuals "no longer as mere recipients of knowledge (…) but as possessors of knowledge and experience" (Felt, 2010, p. 75). As a result there are increasing calls to actively involve more people in political decision-making about science and technology.

In this context transdisciplinarity is seen as a promising new form of governance (Bogner et al., 2010; Frodeman et al., 2010), without however there being clarity as to who has expert status and what such a form of participation would look like (Maasen & Lieven, 2006). In principle, countries with a democratic form of technology development, which already have a culture of citizen participation in political decision-making processes, are given a key role. "A democratic model of civic science will

enhance active citizenry, public engagement and scrutiny" (Durant, 1999, p. 317, as cited by Bäckstrand, 2003, p. 36). However, there are so many conditions that must be fulfilled before such a participatory approach to the shaping of technology policy can be attempted that it should be seen more as an exception than the rule, even in countries with a pioneering role (Brand and Karvonen (2007: 29) name Denmark, the Netherlands and Germany as models). Nevertheless the advantages of such a "civic expert model" cannot be dismissed out of hand, as greater involvement of civil society experts means better (in the sense of more reasonable) decision-making.

In the end transdisciplinarity will most probably establish itself as a new participative form of scientific practice and culture in society's involvement with sustainability, whereby its value can be found in knowledge communication rather than in knowledge production (cf. Feindt et al., 2007, p. 260). It is however equally certain that in the varied choreography of the cooperative interrelationship between science and society this form can hardly stand alone, since for the many epistemological and ontological problems of our time there cannot be – as shown in the arguments presented above – a single model approach that provides the answer to everything.Main text paragraph (M_Text).

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