If post-normal science is the solution, what is the problem? The politics of activist environmental science

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Abstract

Post-normal science (PNS) is presented by its proponents as a new way of doing science that deals with uncertainties, value diversity or antagonism, and high decision stakes and urgency, with the ultimate goal of remediying the pathologies of the global industrial system for which, according to Funtowicz and Ravetz (1993, 739) existing science forms the basis. We critically examine whether PNS can fulfil this claim in the light of empirical and theoretical work on politics and policymaking. We credit PNS as innovative frontrunner in raising important issues regarding the limited problem-solving capacity of ‘normal science’ and ‘professional consultancy’. Yet, we notice that PNS lacks important considerations about the governance of problems and aspects of participatory and deliberative democracy. PNS in effect implies that methodological ‘ratiocination’ would prevail over political deliberation and democratic interaction, and that merely changing scientific input in public policymaking would have the power to change its outcomes. This scientistic hubris can be traced back to PNS’ origin in concerned scientists’ activism, which in effect accessed the political arena through the scientific entrance. We conclude that the art of politics needs to come back into the discussion on environmental problems if societal change is to occur.

Keywords: post-normal science, science-policy interface, boundary work, frame reflection, policymaking, power, problem typology

1 What we are going to do

In this paper we will analyse the potential of PNS to fulfil its own objectives from a political and policy science perspective. We argue that presenting PNS as ‘science’, while at the same time advocating changes to policy making processes, was conceptually fuzzy and unhelpful. Getting things done in the policy arena involves more than providing the right science: it involves doing politics, i.e. using power and influence strategically. To all intent and purpose, with their proposal for PNS Funtowicz and Ravetz engage in politics with a political agenda that can be described as ‘green’ and ‘democratising’. ‘Green’ because they want PNS to help
solve environmental problems, ‘democratising’ because they want to include actors whose (environmental) values are at present underrepresented in designing solutions. This is indeed a political agenda and not only a normative choice for a particular type of research. Policy issues of risks and environmental concerns are resolved in the political arena, and it is there that decisions are made who can participate in decision making, including the designing of solutions (using PNS or normal science or professional consultancy). To discuss this political agenda and its consequences on the effectiveness of PNS is the theme of this paper.

In Section 2 we show how the PNS proposal was steeped in politics although presented as a new way of doing science. This contradiction helps to explain why PNS has been implemented either as a scientific method for making uncertainty explicit, or as a sensitising concept (Section 3). We suggest that reframing PNS as a proposal for policy analysis with deliberation and governance as separate elements clarifies how PNS has fared since its launch (Section 4). We build up an understanding of the governance aspects of such a PNS-type policy analysis from policy science literature, along the way explaining why PNS ran into resistance at several governance levels. We thereby aim to contribute to cross-fertilisation between two bodies of literature: STS and policy science.

2 The political agenda of post-normal science

In their well-known 1993 paper Funtowicz and Ravetz state the objective of post-normal science (PNS): ‘science is now called on to remedy the pathologies of the global industrial system of which it forms the basis’ (Funtowicz and Ravetz 1993, 739). This new, PNS method for doing science was tasked with ‘cleanup and survival’ (Ravetz and Funtowicz 1999, 641), to be an ‘emerging science’ that can deal with ‘the environmental crises of this century’ (Ravetz 2006, 275). In case of the high systems’ uncertainties, intense value contestation, high decision stakes and political urgency in environmental problems they recommend doing PNS because ‘the puzzle-solving exercises of normal science [...] are no longer appropriate for the resolution of policy issues of risks and the environment’ (Funtowicz and Ravetz 1993, 750). In contrast, in PNS ‘uncertainty is not banished but is managed, and values are not presupposed but are made explicit’ (Funtowicz and Ravetz 1993, 740).

Underlying their framing is a distrust in scientists’ willingness and ability not to speak only for commercial or regulatory interests, which is one reason why they consider that traditional scientific peer-review is not enough to guarantee provision of information. Ravetz (2003) asserts that ‘[t]he attempts at an ‘experts’ monopoly’ of the management of risk problems failed signally’, mainstream science is reductionist in style and increasingly linked to industry, while ‘regulators try to control [the risks] [...] while allowing technology to proceed’ (Ravetz 2003, 812). Funtowicz and Ravetz’ strategy to counteract this experts’ monopoly is to extend the peer review, for ‘[o]nly a dialogue between all sides, in which scientific expertise takes its place at the table with local and environmental concerns, can achieve creative solutions to such problems [...]. Otherwise, either crude commercial pressures, inept bureaucratic regulations, or counterproductive protests will dominate [...]’ (Funtowicz and Ravetz 1993, 751). They propose ‘the inclusion of [...] legitimate participants [...] For example, persons directly affected by an environmental problem [...] perform a function analogous to that of professional colleagues in the peer-review or refereeing process in traditional science [...]’ (Funtowicz and Ravetz 1993, 752). These formulations indicate a commitment to a political agenda which is ‘green’ as well as ‘democratising’. While the latter can justifiably be
a political objective on its own right, Funtowicz and Ravetz present it as an instrumental precondition for achieving better environmental management.

In their 1993 paper Funtowicz and Ravetz thereby display a great faith in science’s ability to bring about changes in society’s dealing with environmental problems. They imply that these problems will be solved if the right kind of science is being done, and vice versa: that modifications to scientific practices are essential to solving the environmental crisis. They are careful to stress that PNS is a way of doing science. For example, when discussing the involvement of extended peer communities, Funtowicz and Ravetz assert that this serves to improve the quality of the science, not as a way to get involved in political decision making. They explicitly limit the involvement of extended peer communities to ‘debates on quality’ (Ravetz and Funtowicz 1993, 752), although ‘[o]n occasion, the legitimate work of extended peer communities can even go beyond the reactive tasks of quality assessment and policy debate [and] involve concerned citizens doing the disciplined research’ (Ravetz and Funtowicz 1993, 752 our emphasis). In PNS ‘[t]he problems are set and the solutions evaluated by the criteria of the broader communities. Thus post-normal science is indeed a type of science, and not merely politics or public participation’ (Funtowicz and Ravetz 1993, 751). At the same time they imply that the inclusion of extended peer communities ensures dealing with values and stakes: ‘values are not presupposed but are made explicit’ (Funtowicz and Ravetz 1993, 741) and ‘all those with a stake in the dialogue on the issue’ are invited to participate in peer review (Funtowicz and Ravetz 1993, 739). How ‘merely politics or public participation’ and dealing with values and stakes differ from framing and putting problems on decision agendas, and evaluating and adopting solutions on behalf of broader communities they do not explain: this may be exactly what politics and public participation are all about.

While the 1993 presentation of PNS stressed its scientific character, in his 2006 reassessment of the purpose and success of PNS Ravetz accepts that ‘PNS has always had strong political aspects’ (Ravetz 2006, 276). In his view, involving an extended peer community is at the core of this political commitment (Ravetz 2006, 275), through which ‘PNS can help to shape a new ‘science of, by and for the people’ (Ravetz 2006, 277). At the same time, he recognises that ‘[g]iven all the complexities and value commitments in the situation, the ‘science’ cannot realistically or reasonably be expected to be trivially conclusive for the ‘policy’. [...] Hence the dialogue is not so much one of scientific demonstration, but rather of negotiation, where the science is one element among several’ (Ravetz 2006, 278). This negotiation is of course the essence of politics, where strategic behaviour and the use of power are rife – and this is not always the ‘negotiation in good faith’ Ravetz would like to see (2006, 278). While admitting the limited role of science in decision making he still concludes that ‘the theory of Post-Normal Science is now approaching obsolescence’ and needs to be replaced by a ‘new basic insight [...] based on my qualitative version of complex systems theory’ (Ravetz 2006 275). As in 1993, he identifies the reason for societal problems as a scientific misconception of what these problems entail and where they originate, assuming that the ‘right’ political choices will be made if underrepresented, less powerful groups are invited to contribute to the search for solutions. However, such modification cannot deal with antagonistic strategies amongst political actors as it assumes an environment without power differences, as in Habermas’ communicative ethics and especially the conditions for ideal speech (Habermas 1981).

\[1\] although this is denied by Turnpenny et al. (2009) when they say that ‘[..] democratisation may not have been the original intent of PNS’ (Turnpenny et al. 2009, 348)
However, to declare PNS obsolete because environmental problems have not been solved or because scientific practice has not become as democratic as hoped for seems to us to throw out the baby with the bath water. After all, if ‘the task for the philosophical critic then was to show that not all problems with a scientific appearance are capable of solution in orthodox scientific terms’ (Ravetz 2006, 276), this task has not gone away today even if ‘uncertainty’ is now an accepted part of the scientific and policy discourses – thanks also to the ideas and efforts of Funtowicz and Ravetz. We believe we can explain the lack of impact as Ravetz perceived it in 2006 from an analysis of the politics of PNS. We thereby concur with Turnpenny et al. (2009) who, in their analysis of the application of PNS, concluded that future research requirements on PNS include ‘[...] particularly the need to more clearly relate theory to different strands of literature on the evidence–policy-making relationship [...]’ (Turnpenny et al. 2009, 347). We introduce some of this literature here, which enables us to propose a more complete framing of what PNS sets out to do. However, first we will examine briefly how PNS has fared since its launch in 1993 as this provides input for our subsequent analysis.

3 Post-normal science as a new method of doing science?

In their well-known 1993 paper Funtowicz and Ravetz present post-normal science (PNS) as a description for a phenomenon they observe: ‘In response to the challenges of policy issues of risk and the environment, a new type of science - ‘post-normal’ - is emerging’ (Funtowicz and Ravetz 1993, 739). However, in their 1994 article PNS is a prescription: ‘The new problems of ecological economics call for a ‘post-normal science’ (Funtowicz and Ravetz 1994a, 197). In Ravetz’ 1999 paper PNS is ‘an insight rather than a theory’ which ‘justifies itself by its usefulness in helping people to understand and manage their problems’ (Ravetz 1999, 642), i.e. PNS is a heuristic. In 2006 Ravetz promotes PNS to a theory (Ravetz 2006, 275) but in the same paper calls it a ‘methodology of solving the policy-science problems’ (Ravetz 2006, 279). So is PNS a phenomenon, a prescription for a new kind of science, a heuristic, a theory, or something else again? We briefly discuss this question by looking at how PNS has been put into practice, i.e. what does it mean to ‘do PNS’. The answer will also start to reveal reasons why PNS is not as successful as its proponents hoped.

Starting from Funtowicz and Ravetz’ papers, the elements that seem to be specific to PNS are: 1) to assess whether the problem is post-normal using the criteria of systems uncertainties, value contestation, high decision stakes and urgency, 2) to assess and/or improve the quality of information using NUSAP and/or extended peer review. Van de Kerkhof and Leroy (2000) suggest that elements specific to PNS are: 1) management of uncertainty, 2) management of inter- and/or transdisciplinarity, 3) management of policy relevance, 4) management of quality. In these summaries, we find it hard to detect something that distinguishes PNS from general current policy analysis theory and practice, except for the use of NUSAP which is specific to PNS (Hoppe 1999; 2002). As a supplementary approach to finding out what it means to ‘do PNS’ we have therefore used the Web of Knowledge to produce a list of references with the search terms ‘post-normal science’ or ‘NUSAP’ in topic or title. The work thus selected was explicitly classified as PNS by its authors; this avoids us having to produce our own (contestable) criteria for judging whether something counts as PNS. Googling the term ‘post-normal science’ did not yield any results beyond academia, except
for a recent public conflagration around a Guardian newspaper article by Mike Hulme on climate change science, but he is an academic and so were his detractors (Hulme 2007)².

In our rapid assessment of the almost 100 references produced by this Web of Knowledge search, we find on the one hand specific methods and applications for dealing with uncertainty, and on the other more general cases of deliberative procedures for dealing with wicked environmental issues that are described as ‘PNS’. The majority of the papers falls in this second category. Here, PNS is a ‘sensitizing concept’ that alerts readers to the need for a PNS approach, either because the problem type is wicked, and/or because the eco-social system is large and complex. Generally in these papers there is no indication how exactly PNS can be done, beyond a mention of ‘dialogue’ or ‘stakeholder participation’ and/or ‘working at the science-policy interface’. There are other papers with the inverse reasoning: a process of inquiry about a problem assessed as post-normal is labelled PNS just because it involved public participation (e.g. Hisschemöller et al. 2001). Without specifications about the purpose and modalities of such a set-up it is not clear why this should be named PNS and not a deliberative process like many others, described e.g. by Renn (2008).

We also find examples where PNS is used in a stricter sense: to map, communicate and discuss uncertainties, which may or may not be related to risks, and/or to improve the quality of information by extended peer review. A few years before launching the concept of PNS, Funtowicz and Ravetz proposed the NUSAP system to structure the provision of information about the different types of uncertainty that affect scientific information (Funtowicz and Ravetz 1990). NUSAP assesses the quality of quantitative information by means of five qualifiers: Numeral, Unit, Spread, Assessment, and Pedigree (www.nusap.net). A few scientists have worked with the NUSAP scheme. One of them is Funtowicz himself, who has continued elaborating application of PNS through his work for the European Commission on the precautionary principle (Saltelli and Funtowicz 2005). In the Netherlands NUSAP was applied by Van der Sluijs and collaborators (Van der Sluijs et al. 2005). PNS was also used in the Guidance for Uncertainty Assessment and Communication (Jansen et al. 2005) for the Dutch National Institute for Public Health and the Environment (RIVM). Its usage, both within RIVM and in communications with its customers, turns out to be limited, probably because the guidelines were not developed and/or discussed with internal and external users (De Vries 2008). This is rather ironic given that PNS stresses the involvement of extended peer communities for producing quality information.³

There may be more profound reasons why policy makers find scientific information about uncertainties unappealing and which point to the need to understand the politics of doing PNS: it turns a presentable ‘policy story’ with a beginning, middle and end into a non-story, robbing it of its structure that was based on facts and effectively disallowing a conclusion (Roe 1994, 5). Funtowicz and Ravetz’s emphasis on uncertainty in the knowledge base could then have the opposite effect to what they intended. Merely increasing uncertainty around the dominant policy narrative generally triggers political pressures to retain the ‘old’ one (ibid.). Lindblom (1959), Simon (1955) and other early contributors to empirically-based theories of decision making describe how policy processes generally deal with complexities, uncertainties, lack of knowledge and disparate values and interests. Their investigations led to a formulation of a theory of policymaking as intertwined cogitation and interaction. Lindblom (1965, 1977) concluded that ‘[i]nteraction often serves as a social method of analysis [...] an

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² This paper was revised when ‘Climategate’ broke. It remains to be seen whether PNS-type analyses will have any impact on its consequences.

³ At present, one of the authors is involved in efforts to remedy this situation
alternative to ratiocination for taking account of numerous considerations that ought to be incorporated into an intelligent collective outcome’ (Woodhouse and Collingridge 1993, 132). Although Funtowicz and Ravetz favour this interaction when they advocate deliberation, they put modification of scientific methods central in their solution and thereby implicitly disagree with ‘the lynchpin of Lindblom's thinking [...] that analysis could be, and should be, no more than an adjunct to interaction in political life’ (Woodhouse and Collingridge 1993, 132). Rather than to trust the ‘intelligence of democracy’, however imperfect it may be in contemporary political systems, Funtowicz and Ravetz thereby in effect privilege ‘ratiocination’ over deliberation.

In conclusion, there are some concrete examples of the application of PNS as a method to make uncertainties explicit, although here, too, the relation with policy making is not unproblematic. However, the majority of examples labelled ‘PNS’ describes modes of policy analysis that are indistinguishable from other examples of participatory or deliberative policy-analytic exercises not labelled PNS. Here, PNS is a sensitising concept that alerts to the existence of certain problems, rather than a distinct method for dealing with them. Indeed, more than 20 years after PNS was launched, Turnpenny et al. (2009) conclude that ‘[i]t is rather difficult to pin down detailed criteria for assessing the degree of ‘post-normality’ of activities and practices’ (Turnpenny et al. 2009, 350) and proceed to study the practice of PNS through cases that were not actually explicit attempts to implement a PNS approach but where, in their assessment, ‘elements of PNS are actually used in practice to address wicked issues’ (Turnpenny et al. 2009, 348). Their finding that actual PNS applications are rare would explain why in 2006 Ravetz continues to argue that PNS ought to be implemented, without reviewing actual applications (Ravetz 2006).

If PNS was successful as a sensitising concept, this is apparently not sufficient for ‘doing PNS’. To extend the PNS theory, we suggest a possible way forward by examining the politics of PNS more closely and from this derive how its conceptualisation should be revised for it to become more effective at achieving its goals.

4 Including politics in a post-normal science framing

We contend that an more comprehensive framing of science in and for policymaking will provide insight into the supposed failings of PNS to bring about the envisaged policy changes. The fundamental flaws in the implicit PNS conceptualisation of policymaking and the role of science prevent an understanding of the limited usability of a PNS approach to science-for-policy. PNS is in that respect no different from many contemporary science-for-policy methodologies proposed in and for environmental problems like integrated assessment, interdisciplinarity, adaptive management, transitions, social learning, etc. This means that ‘the art of politics must come back into the discussion [on environmental problems] if change is to occur’ (Ingram 2008, 1).

From the above discussion it is clear that PNS frames the search for solutions in terms of doing science (after all, it is post-normal science). At the same time, participatory and deliberative processes and environmental policy choices are woven into the PNS-as-science framing. Since PNS is steeped in politics, to conceptually separate the three activities of policy making, deliberative processes and science (post-normal or other) will offer much-needed clarification of the objectives and possibilities of PNS. This would allow PNS to become an approach for understanding and dealing with environmental problems.
Pellizzoni’s (2003) conceptualisation of participatory technology assessment (PTA) as the intersection of practices of governance, deliberative democracy and (new) science is a useful analogue to clarify PNS (see Figure 1). With their interpretation of uncertainty as ignorance and indeterminacy and their demand for extended peer review, Funtowicz and Ravetz place PNS firmly in the ‘new science’ compartment. At the same time, they present this new science as if it were a comprehensive tool for more democratic and improved governance (centre of Figure 1) because they include deliberation and governance issues in the PNS method, based on arguments about complexity of the knowledge base and fundamental ambiguity and contestation around values. Unfortunately, while Funtowicz and Ravetz were aware that their proposition was politically charged (Ravetz 2006), they did not explore the consequences for the success of their course of action. Below, we elaborate how our re-conceptualisation explains why PNS encounters resistance, and hence also what it needs to do to advance its cause.

Figure 1 PNS as science, governance and democracy (adapted from Pellizzoni 2003)

After briefly discussing well-known pitfalls of the involvement of extended peer communities, we focus on the governance component of PNS which has received much less attention. We explore the meta-level of agenda setting where priorities are decided, through the governance of problems where wicked problems are framed, to the boundary work between science and politics and the balance between power and rationality in problem processing. In doing so, we reflexively use these insights to explain where and why Funtowicz’ and Ravetz’ encounter resistance to the application of PNS.
4.1 Post-normal science and deliberative democracy

The proposal to include less powerful actors in policy deliberations ‘exposes and clarifies the political dimension of specific practice’ by challenging ‘the presumption that anything ‘scientific’ must be free of uncertainty, independent of values, and the exclusive possession of a technocratic elite’ (Ravetz and Funtowicz 1999, 642). They were not the first to conclude this (Hoppe 1999). For example, Weingart has published detailed analyses of scientists’ interactions with politics since 1970, showing how both worlds get ever more entangled (e.g. Weingart 1982). In his 1980 essay on the political context of scientific advice, Ezrahi describes how ‘scientific knowledge can be drawn upon to serve political ends in contentions about public policy […] It may very well mean, particularly when there is disagreement about the objectives of policy, that science is utilised for its political rather than for its intellectual value’ (Ezrahi 1980, 127). Finally, Jasanoff’s seminal 1990 book ‘The fifth branch: scientists as policy advisors’ deconstructs the same arena of risk analysis that is Funtowicz and Ravetz’ initial concern.

The political agenda of PNS does not end with this advocacy for the inclusion of non-experts in deliberations about the quality and policy implications of scientific evidence. Its ‘deep political commitments’ (Ravetz 2006 277) are to changes in environmental management, initially formulated as ‘remedy the pathologies of the global industrial system’ (Funtowicz and Ravetz 1993, 739). Ravetz’ formulation of the political agenda of PNS has since evolved into the assertion that ‘science will need to be done in the cause of justice and sustainability’ (Ravetz 2006, 277). However, just how the inclusion of extended peer communities can or will remedy the pathologies of the global industrial system or deliver justice and sustainability is not clear from the founders’ texts. They recognise that ‘[p]ublic agreement and participation, deriving essentially from value commitments, will be decisive for the assessment of risks and the setting of policy’ (Funtowicz and Ravetz 1993, 751) but they do not elaborate whether environmental protection is part of these commitments, or what the effect may be if they are not. After all, ‘environmental preferences of the involved actors determine the environmental outputs (and outcomes) of decision-making’ (Newig and Fritsch 2009, 210). They also seem to imply that big industry and other economic interests do not count as a stakeholders (or they would overrule environmental concerns); nor do they explain how to act if stakeholders have opposite views and priorities. In fact, by talking of ‘stakeholders’ in general they justify the role of business in environmental management, while their explicit purpose is to counter balance the power of big business.

In a recent workshop, Ravetz recognised these political aspects of deliberation. He attributes failures to achieve sustainability to the fact that not everybody who should be included is invited to contribute: ‘It is hard to avoid the conclusion that we have an ongoing situation of ruthless firms and toothless watchdogs. […] The description of the work of the Extended Peer Community did mention activist engagement of various sorts, but the need for this was not spelled out’ (Ravetz 2008). However, it should be clear that inviting less privileged groups is not sufficient to change the course of policy making. In the remainder of this Section we explore the other elements of governance where PNS intervenes with existing power relations.

4.2 Agenda setting as meta-governance

If, as we assert, PNS has a strong political agenda, the analysis of its successes and failures should start with the way in which political priorities are decided. Ravetz correctly observes that governments have to somehow reconcile contradictory roles of ‘acting both as promoters
of global business enterprise and also as regulators on behalf of a sophisticated and suspicious public’ (Ravetz 2003, 811; original statement of this view in Rip et al. 1995). We agree that the pathology of the present global industrial system is its relentless drive for profits through market-type efficiency which disregards external costs: mass migration, damage to health, damage to nature, and many more. It is exactly because of the incompatibility of the political-economic and biophysical paradigms that PNS-type extended peer review could come in as a way for the governance structure of human societies to successfully adapt to changing circumstances. However, as we have already discussed, it is no foregone conclusion that deliberative processes will indeed prioritise sustainability over economic interests. Second, the political choice for deliberation is not shared by relevant others. Many politicians, political scientists and citizens believe that representative democracy is superior to deliberative democracy exactly because it is better adapted to complex, large-scale socio-political systems. Also, not only neo-conservatives and neo-liberals believe the market system to be superior as a societal coordination mechanism exactly because it handles the complexity of (economic) transactions in coordination between billions of people all over the globe better than systems of central coordination (Lindblom 2001). It is hardly surprising that these scientists who prescribe a move towards deliberative democratic procedures in order to adapt better to the complexities of the current socio-economic-politico-ecological system run into resistance from vested interests and well-engrained institutions as they imply that political, economic and scientific elites ought to cede parts of their power and control to others. This is a reality they need to take into account, even if those same elites apparently subscribe to the arguments for change.

Ironically, while exploiting the idea of bio-physical complexity Funtowicz and Ravetz’ argument for extended peer review therefore disregards the complexity of modern governance. Without explicit attention to institutional alignment such ideas will never be successfully ‘exported’ to governance structures outside science. Limiting ourselves to the institutions of political democracy\(^4\), processes of deliberative democracy have to be aligned with representative democracy and neo-corporatist policymaking in many policy subsystems. Goodin and Dryzek (2006) call this the problem of ‘macro-political up-take of mini-publics’ while Edelenbos et al. (2008) frame this as ‘democratic anchorage of interactive governance’. While Funtowicz and Ravetz aim to integrate different values and represent stakes in extended peer communities, this is not sufficient to ensure that subsequent policy decisions take account of the results. On the contrary, in the view of many politicians including non-experts in scientific peer review means less rather than more authority and credibility. In that sense, PNS may have been counter-productive in terms of its own expressed intentions.\(^5\) Moreover, many experiments with deliberation are actually commissioned by decision makers who owe this position and role to the power-mechanisms in representative democracy (e.g. Loeber 2004). ‘Doing it deliberatively’ is just one option out of many for these authorities in getting decisions and policy out of the political ‘machine’. By keeping open the option for themselves to not even respond to recommendations, they give the impression of not taking seriously procedures they have themselves set in motion (Joly and Marris 2003). Small

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\(^4\) For a full picture one would have to include complex and volatile multi-institutional alignments with markets, firms, civil society organizations and associations, and individuals as consumers, citizens, and members of households.

\(^5\) The scientists who vehemently protested at Mike Hulme’s assertion that climate change science is post-normal have understood that this claim diminishes their authority. See the article (Hulme 2007) and the subsequent exchange:  [http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange](http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange)  See also Kysar (2008).
wonder that many advocates of deliberative procedures, Funtowicz and Ravetz included, get disappointed about the lack of changes brought about by such experiments.

What is actually needed at this level of agenda-setting is a sustainability meta-governance that covers the full complexity of institutional alignments. So far we can only hope that this will happen, as economic concerns remain paramount. As Baumgartner and Jones (1993) say in their theory of long-term policy dynamics: under conditions of rapid change and entrance of new policy players old policy subsystems crumble and new policy networks may emerge. But apart from hoping for this to happen spontaneously, perhaps some deliberate political steering is possible in the form of ‘institutional entrepreneurship’ (Hoppe 2010). The concept was coined by DiMaggio (1988) who held that ‘new institutions arise when organized actors with sufficient resources see an opportunity [...] to realize interests that they value highly’ (DiMaggio 1988, 14). Policy entrepreneurs are nudging the existing policy network in a more desired direction by reframing the policy problem and rethinking the conditions for this new frame to become legitimate. With their propositions to reframe environmental problems and their emphasis on urgency and democracy Funtowicz and Ravetz are trying to do this. The trouble with PNS is that science cannot jump over its own shadow: it is part and parcel of the complex governance structure which it tries to influence, while the translation work of institutional entrepreneurs depends on their locus at the margins or ‘above’ policy networks. Being familiar with more than one policy framing and policy-political logic enables them to think more innovatively than the network ‘insiders’. In addition, they can draw on financial and communicative resources outside the normal network structures to bolster their efforts.

However, policy entrepreneurship is by no means a sufficient condition for bringing about the desired changes. The system is simply too complex and self-controlled to be amenable to meta-governance by powerful leaders. In societies like ours, with complex, overlapping, partially contradictory governance subsystems, the only way to ‘steer’ is by using the forces and drivers already present: to ‘interpolate’ small doses of change in such ways that the balance of forces is changed in the desired direction (Dunsire 1986, Hood 1986). This policy-cum-institutional entrepreneurship is an essential ingredient of a political system in the responsive and creative governance of problems. At this level of meta-governance, the value of PNS as sensitizing concept is in sparking off bits and pieces of institutional and policy entrepreneurship which may, ultimately, build up to a new governance structure fully adapted to the threatening alterations in society’s biophysical environment. However, this is insufficient in itself.

4.3 The governance of problems and problem types

In addition to their activities as policy entrepreneurs, Funtowicz and Ravetz are also implicitly trying to exert influence at the level of the politics of problem framing. Here, problems are deliberately and strategically framed in order to mobilize political and social support (Schattschneider 1988). We will show that conceptually they try to redefine the problem type and thereby also the way it is dealt with. In doing this they challenge well-established policy networks and practices, thus encountering resistance at this level. too. Our analysis now supposes that sustainability has indeed made it onto the political agenda and has been identified as a policy problem requiring some form of collective response, as is indeed the case in western societies. The question then becomes: how to arrive at this collective response, i.e. how to go about developing policies? Generally speaking, this depends on how powerful decision makers structure the problematic situation. Using the social study of organizations (Thompson and Tuden 1957), science and technology (Ezrahi 1980), and public
policy (Van de Graaf and Hoppe 1989), Hisschemöller and Hoppe (1996) have captured different ways of structuring problems in a well-known typology (Figure 2). It rests on a definition of a problem as a deviation between an ‘is’ and an ‘ought’. The ‘is’ is the available relevant knowledge for understanding the problem, in which there can be more or less certainty. The ‘ought’ is represented in the norms, values, ideals and interests at stake in defining the problem, in which there can be more or less ambivalence or ambiguity. These two dimensions yield four problem types.

![Figure 2 Typology of problem structures (Hisschemöller and Hoppe 1996)](image)

Participants in policymaking generally try to steer debates into the quadrant where they can win the dispute, or where opponents are not likely to win (Schattschneider 1988). In this problem structuring, implicit and explicit choices are made about what to include and what to ignore, i.e. the problem is limited in scope by selecting a particular frame. This means that problem structuring moves a moderately or unstructured problem into one of the other quadrants, after which an appropriate, sometimes scientifically endorsed strategy will enable dealing with the problem, at least temporarily. This enables actions to be taken towards solution, although frequently it cannot be expected that these are more than temporary settlements which bring only incremental improvements (Lindblom 1959, 1965; Hayes, 2001).

Each problem type has a distinct politics of policymaking and concomitant problem processing strategies (Figure 3). Structured problems are solved by a debate on technicalities of fine-tuning the means to achieve objectives; moderately structured problems with shared goals lead to debate on the (evaluation of) a set of means. Structured problems are attractive to politicians and policymakers because they have a track record of ‘do-ability’ (Rittel and Webber 1973): a feasible, well-understood method exists that satisfies all criteria for an adequate, successful solution. This is exactly the function of ‘normal’ science as problem solver. Even if they realize that most politically salient problems are not quite fully structured, policymakers want to move problems into the quadrant of structured problems rather sooner than later so they are seen to have solved the problem (March and Simon 1993, Schön 1983).
By arguing that certain problems are ‘post-normal’ Funtowicz and Ravetz engage in the governance of these problems. They argue against ‘normal’ do-ability when they assert that ‘facts are uncertain, values are in dispute, stakes are high and decisions urgent’ (Funtowicz and Ravetz 1993, 744). Conceptually they are thus trying to move environmental or sustainability problems that were considered (moderately) structured clean-up or externalities problems by policymakers and scientists alike into another quadrant. Any such effort at re-classification challenges accepted problem solving strategies and thereby the division of labour among participants in the policy network that has emerged to perform this. In the iterative policy process of problem framing and solving policy players attempt to gain authoritative acceptance for their claims through persuasion, bargaining and other processes of partisan mutual adjustment (Figure 4). The serial character of rounds of policymaking can lead to the institutionalization of certain problems as ‘permanently’ structured, where one problem framing becomes the hegemonic problem definition.

Policy implementers puzzle about alternative solutions within the bounds of the set of constraints implied by the dominant problem definition, and professional or academic advisers make discoveries about the pros and cons of the constraints. The resulting learning processes, and/or external political events, may lead to novel critical moments, which may lift (some) older constraints, or introduce new ones. The historical sequence of such processes creates path dependencies in problem definitions and constraint sequencing as well as a policy network that dealt with them. Such path dependencies either facilitate or work against the adoption of novel problem/solution couplings. This explains part of the resistance that Funtowicz and Ravetz have experienced in trying to bring about changes in the dominant problem definition, while this framing is critically important as ‘[a]mong the critical shortcomings in contemporary [environmental] politics are the failures to frame issues in ways to attract public interest, to engage a[n environmental] ethic and to address deep seated inequities, to recruit and to inspire leaders’ (Ingram 2008,1).

In addition, we question whether Funtowicz and Ravetz place environmental problems in the correct problem category when they propose their framing. Although they mention that
‘values are in dispute’, they at the same time seem to assume that there is societal agreement on the need to deal with these problems urgently. The problem type they thereby assume is reflected in the category of moderately structured problems for which there is agreement on goals (MSP(g) in Figure 3). However, we believe that post-normal problems should be considered unstructured (UP in Figure 3). There is no agreement in society on a priority for sustainability over e.g. economic development, and there is certainly no agreement over what sustainability entails. Funtowicz and Ravetz’ implicit classification of post-normal problems as MSP(g) can explain further the disappointing impact of PNS. Whereas UP problems demand efforts like an agonistic politics of agenda-changing, where possible combined with learning through deliberation and participation (Figure 3), MSP(g) problems can often be solved by relatively ‘normal’ problem-driven searching and negotiation. With their preference for ‘ratiocination’ they employ the wrong-problem processing strategy: one that fits MSP(g) and not the UP that post-normal problems represent.

![Diagram of problem structuring](adapted from Vergragt 1988, 503)

4.4 Policy politics and the role of scientific information

It is clear that problem structuring is a politico-cognitive necessity in dealing with unstructured and moderately structured problems. Problem structuring may be dominated by a puzzling or powering style. Dunn (2007, 6) defines the puzzling style as the self-conscious search, analysis and evaluation of competing problem representations and problem framings, with a view to their possible integration and definition. In a more political twist, problem structuring could be defined as the political activity to produce information on divergent views of what the problem is about, with a view to produce a synthetic, or at least politically plausible, problem definition (Hisschemöller and Hoppe 1996). In practice, problem structuring is, at best, an oscillation between ratiocination and rationalization. Much more likely, it is a complex two-level real-time knowledge/power game; like the next move on the chess board being determined by the outcome of a boxing match, and vice versa. This dual nature of problem structuring as cogitation and political interaction, as powering and puzzling, is inevitable because determining whether or not to open up or close down a debate, and whether or not to allow the closure of particular constraints, always entails political
struggle. This is especially true for unstructured problems because there are no logical or inherently ‘rational’ criteria for beginning or ending infinite disputes.

Problem structuring as puzzling looks identical to the deliberative processes proposed by Funtowicz and Ravetz. In their original conceptualization they believed that external peer review could be sufficiently insulated against the influence of ‘politicking’. Yet this flies in the face of experience. Those in power define what counts as ‘rationality’ and knowledge. The relationship between power and rationality in problem framing is asymmetrical: ‘[..] power has a rationality that rationality does not know. Rationality, on the other hand, does not have a power that that power does not know’ (Flyvbjerg 1998, 234). In the formulation of Ezrahi (1980) there is a ‘preponderance of political considerations in the formulation and execution of public policies. The process of democratic politics consists of endless conflicts, negotiations and temporary compromises; legislatures and public bureaucracies which [..] are not under compelling pressure to integrate scientific knowledge and technical standards into their activities. [..] It is our task to understand how scientific knowledge does become woven into the political and bureaucratic formulation and execution of policies’ (Ezrahi 1980 111). Following Ezrahi’s suggestion to trace the ways in which scientific information is input into the process under different conditions of policy politics. Based on empirical studies of dozens of Dutch cases, Hisschemöller et al. (2001) proposed the following typology for the role of science as dependent on problem types (Figure 5).6

![Figure 5 Problem typology and the role of science (Hisschemöller et al. 2001, 464)](image)

6 Note that Hisschemöller et al. (2001) use low-profile descriptive labels to describe the roles of scientists, and avoid high-level normative labels like Pielke’s (2007) ‘honest broker’ or ‘stealth advocate’, or Jasanoff’s (2003) revival of Mertonian norms as ‘technologies of humility’.
4.5 Boundary work on the science-politics interface

If the Hisschemöller et al. (2001) typology is generally valid, the implication of different problem typologies is that ‘the [authoritative] problem structure limits the opportunities for scientists to shape their own roles in environmental policymaking, as they are bound to play a specific role either as problem solver, as advocate, as mediator, or as problem finder. Therefore, science use depends on the structure of the problem as constructed by dominant policy actors at a given moment, and the informal rules of the game that drive the policy process’ (Hisschemöller et al. 2001, 465). From descriptive studies of boundary work and boundary organizations we know that the relation between experts and policy makers is a complex and contested division of labour. This division of labour consists of a boundary that demarcates who can and cannot be considered an expert in various degrees, and articulates the coordination between actors who have come to be considered ‘experts’ and ‘policy makers’. Such boundaries are the outcome of – and form the resources for – continuing boundary work, the further articulation, reproduction, or modification of this division of labour (Halfmann and Hoppe 2006, 135). While these constraints clearly exist, this does not mean that scientists do not try to escape from them, as Funtowicz and Ravetz show. PNS is relatively successful in a role as problem solver (SP square) and problem analyst (MSP-g) through its method for assessing uncertainties such as NUSAP, or as problem recogniser (UP square), with PNS as sensitising concept. These are then apparently roles that are accepted in the current boundary arrangements around environmental problems. However, when they try to take a role as advocate (MSP-g square) or mediator (MSP-m square), Funtowicz and Ravetz encounter opposition: these roles are apparently not yet part of the accepted arrangements, and to change this requires political struggle and gradual institutionalisation.

An understanding of the political agenda of PNS from a boundary work perspective is thereby the last element of our explanation of the resistance encountered by Funtowicz and Ravetz and other PNS enthusiasts. In trying to escape from the limits to their role imposed by the dominant problem framing and its resultant prescriptions, they unwittingly engage in boundary work between science and policy because as scientists they ‘transgress’ onto the political side of the boundary. Hoppe (2005) describes eight theoretical boundary arrangements which he classified on the basis of two dimensions: whether the primacy lies with science or politics, and whether science and politics are seen to converge or diverge in their essential social functions. He then studied how Dutch policy workers themselves conceive of the division of labour between science and politics (Hoppe 2009). He found considerable overlap between the theoretical and the actual discourses. In sustainability-related policy domains (such as agriculture, environment, water management) policy workers could nearly all be classified as ‘post-normalists’ (which is more general than PNS as a specific concept). These policy workers believe in the need for and possibility of convergence between politics and science in order to serve society, i.e. in solving environmental problems. They expressly acknowledge the primacy of politics, while simultaneously claiming that science is not just serviceable but has an autonomous responsibility. Post-normalists’ framing of their policy work is therefore full of contradictions: on the one hand, they distrust democracy to set the ‘right’ priorities (science is autonomous) and on the other hand they insist on extensive deliberation to bring about desired changes in environmental policy because they realise that they depend on politics to make the right decisions (primacy of politics). These are also the contradictions apparent in Funtowicz and Ravetz’ presentation of PNS.

To find many post-normalists amongst experts in sustainability-related policy areas is no Dutch coincidence. In the US and Canada too, it has been found that scientists working in
sustainability-related policy domains hold views that are best described as ‘post-normal’ (Steel et al. 2004). This general finding results from a conjunction of three causes: complexity in the knowledge base, instability of policy networks, and lack of political clout. First, the physical systems that sustainability-related boundary workers work with are now widely recognised to be characterised by complexity, which results in uncertainty about and unpredictability of information. The complexity also generates a need to work with other disciplines. Both factors undermine the boundary workers’ substantive authority. Second, post-normalists operate in relatively new policy networks where relationships are anything but settled, not within the traditional government structures, nor with an expanding number of civil society organizations and stakeholders. Third, sustainability-related issues tend to be low on the list of political priorities, if not in rhetoric then in practice, with economical interests usually dominating. These three factors create an uncertain position for post-normal policy workers. They try to counteract this uncertainty by forming alliances, hence the emphasis on trust in science-politics dialogue and deliberation, and by re-asserting that their activities are solid science, hence the frequent reference to well-established rules and methods (Hoppe 2009, 16). Funtowicz and Ravetz’s insistence that ‘post-normal science is indeed a type of science, and not merely politics or public participation’ (Funtowicz and Ravetz 1993, 751) is an example of the latter.

5 What next?

We have shown in this paper that Funtowicz and Ravetz were aware that their promotion of PNS had a political agenda, but just how much they did not recognise. Conversely, the PNS approach is not politicised enough to do what they really want to do: to further environmental goals, especially sustainability. So to answer the question asked in the title of this paper, ‘If post-normal science is the solution, what is the problem?’; as it stands PNS can be a solution for flaws in a scientific method, but not for the dual problem of democratisation of, and priority setting for, environmental policy making. Post-normal experts represent disciplines where until recently enlightenment and technocracy models enjoyed much popularity among academic scientists, and bureaucracy models governed their practices as boundary workers in the service of politics and policy. The political salience and societal relevance of sustainability issues is now pressing them to find other, workable models for boundary arrangements. Their advocacy of, and discourse coalition building for, policy on the basis of ecological insights may even express itself as technocracy (Hoppe 2009). In other words: although post-normal policy workers articulate the need for convergence with politics, they try to make sure that this happens on their own terms, not according to democratically set political priorities. Ultimately this means that they enter the political arena as ‘stealth advocates’ (in Pielke’s (2007) terms), but through the back door of science, to find themselves facing political contestation they did not anticipate. For it should be clear that it is a misconception to consider the role of science in policymaking well-defined, either in the normal science or in the post-normal variant. It is this understanding of the variability in science’s role in politics and public policy that is lacking in PNS: Funtowicz and Ravetz are stuck in ‘disillusionment with the power of scientific knowledge to transform and rationalise the decisions and actions of governments’ (Ezrahi 1980, 111). They propose to remedy certain ‘faults’ of scientific practice whereas in fact it is the politics and policy of agenda setting, problem framing and solving and in boundary arrangements where resistances to PNS originate.
Overall, PNS has been much more successful as sensitizing concept than as fully fledged theory or as heuristics for the governance of concrete problems. This is understandable as there is no scientific way to ‘solve’ unstructured societal problems. This is a vital observation in view of the many new tools and methods advanced in environmental sciences that claim to do just that. However, it is possible to make PNS and other interactive and deliberative methods more politically sophisticated, and we actually see these changes starting to happen (e.g. Pellizzoni 2003, Turnpenny et al. 2009). Changes should focus on all aspects of making sustainability governable: 1) the conduct of deliberative policy analyses and its links to the institutions of representative democracy, 2) the boundary work at the science-policy interface, and 3) the advocacy coalition and public persuasion work needed for agenda-setting and societal change. Each of these merits a separate paper but we have space only for a few general comments here.

The literature on public participation and deliberation is extensive and there is a well-stocked and ever-increasing toolkit of methods available. The recommendations to emerge from evaluations of these processes invariably concern three interrelated issues: fostering conditions for real learning, maintaining some sort of power balance between participants with sometimes very unequal resources in the real world, and macro-political up-take in the real world of power differentials in representative democracy and capitalism (Loeber 2004, Edelenbos et al. 2008). The substantial literature on boundary organizations and boundary work provides more strategic lessons for PNS proponents: getting your view to count is all about balancing processes of demarcation (for science’s credibility and authority) and coordination (with a view to relevance and salience) (Halffman 2003, Hoppe 2005). These lessons can be briefly summarized as institutionalized double participation and accountability across the science-policy divide, and co-production of a social and cognitive order e.g. through the use of boundary objects in continuous communication and interaction between policy workers and scientific experts (Star and Griesemer 1989, Guston, 2001, Miller 2001, Hoppe & Huijs 2003, Nutley et al. 2003, Wesselink 2009).

Both participatory-deliberative policy analysis and boundary work are embedded in political environments where substantive knowledge about policy problems competes with political concerns: how harmful is the information for someone’s power position, how many people believe the problem to be important, how much political support is mobilized through tackling the problem, what are its financial and other types of social and political costs relative to competing problems (Webber 1992, Nutley et al. 2003). Whether and how it is possible to achieve any of the recommendations in a given situation ultimately remains a matter of advocacy, convincing, context-sensitive political judgment and political struggle. Even if it is therefore impossible to present universally applicable recommendations, it is important that the political nature of these issues is clear. There is no use for lists of wishful ‘ought to’ recommendations if reality does not comply all by itself: creating space for deliberative experiments, persuading policy makers to listen to scientific findings, and transitions to a fairer and more sustainable world all require political commitment and action. Claiming to have the truer facts and right numbers is only a secondary, though often instrumentally useful matter.

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Notes

1. The NUSAP system is used to structure the provision of information about the different types of uncertainty that affect scientific information (Funtowicz and Ravetz 1990; Saltelli and Funtowicz 2005; Van der Sluijs et al. 2005). NUSAP assesses the quality of quantitative information by means of five qualifiers: Numeral, Unit, Spread, Assessment, and Pedigree (www.nusap.net).
3. Rittel and Webber (1973) introduced the concept of “wicked problems,” where values are contested and uncertainty is high, which is a definition that Funtowicz and Ravetz use and relabel “post-normal” problems.
4. For a full picture, one would have to include complex and volatile multiinstitutional alignments with markets, firms, civil society organizations and associations, and individuals as consumers, citizens, and members of households.
5. The scientists who vehemently protested at Mike Hulme’s assertion that climate change science is post-normal have understood that this claim diminishes their authority. See the article (Hulme 2007) and the subsequent exchange: http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange. See also Kysar (2008).
6. Note that Hisschemöller et al. (2001) use low-profile descriptive labels to describe the roles of scientists and avoid high-level normative labels such as Pielke’s (2007) “honest broker” or “stealth advocate,” or Jasanoff’s (2003) revival of Mertonian norms as “technologies of humility.”

References


Funtowicz S O and Ravetz (1994c) Emergent complex systems Futures 1994 26(6) 568-582


Guston D (2001) Boundary Organizations in Environmental Policy and Science: An Introduction Science, Technology and Human Values 26(4) 399-408

Habermas J (1981) Theorie des kommunikativen Handelns Frankfurt am Main, Suhrkamp


Hoppe R (1999) Policy analysis, science and politics: from ‘speaking truth to power’ to ‘making sense together’ *Science and Public Policy* 26(3) 201-210

Hoppe R (2005) Rethinking the science-policy nexus: from knowledge utilization and science technology studies to types of boundary arrangements *Poiesis and Praxis* 3(3) 199-215


http://www.guardian.co.uk/society/2007/mar/14/scienceofclimatechange.climatechange


Jansen P C (2007) *Beoordeling van de kwaliteit van hoogwaterparameters berekend voor de Nederlandse Maas* MSc thesis, department of Water Engineering and Management, University of Twente http://purl.org/utwente/e704


Turnpenny J, Lorenzoni I and Jones M (2009) Noisy and definitely not normal: responding to wicked issues in the environment, energy and health Environmental Science and Policy 12(3) 347-358


Vergragt P J (1988) The social shaping of technological innovations Social Studies of Sciences 18 (3) 483-513


Wesselink A J (2009) The emergence of interdisciplinary knowledge in problem focused research Area 41(4) 404-413