TOWARDS UNBIASED FORESIGHT PROCESSES FOR POLICY THINKING - A FRAMEWORK FOR RESPONSIBLE SCIENTIFIC ADVICE

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Abstract

This article considers a methodology for quality scientific policy advice. It discusses (1) the roles of systems analysis, foresight and avoiding bias in formulating impartial scientific advice and (2) ways to communicate advice to policymakers that invite them to reflect open-mindedly on the evidence before making decisions. I start with the role of scientific advisory services. Then I give a systems analysis of the science-policy ecosystem as a dynamic open system, which should include feedback loops from policymakers to scientific advisors. Then I give an overview of the biases that can arise in the advisory process. My analysis shows that careful reflection on possible biases in the science-policy ecosystem and systematic foresight thinking will contribute to higher quality scientific policy advice. Furthermore, integrating systems thinking, foresight and bias-awareness in the scientific advisory process will ensure 'Responsible Scientific Advice' (RSA), on analogy with 'Responsible Research and Innovation' (RRI).

Keywords:
Bias, scientific advice, policymaking, foresight, backcasting, interdisciplinarity, system analysis

Introduction

Policymaking is a dynamic process to which scientific advisors contribute by researching and assessing policy options and supplying policymakers with, ideally, a complete, impartial overview of them. As part of preparing policy options for the European Parliament's Science and Technology Options Assessment (STOA) Panel, we follow foresight methodologies to anticipate the possible impacts of current and future scientific and technological developments. Foresight exploration enhances the impartiality and completeness of the resulting policy options. But the entire process of making and advising policy involves the risk of biases. In this paper, I discuss some aspects of foresight research and the role of bias in advising and policymaking.

I start with the role of scientific advisory services. Then I present a systems analysis of the science-policy ecosystem. According to systems theories, the European Parliament's science-policy ecosystem is a dynamic open system that should include feedback loops from policymakers to scientific advisors. An understanding of the ecosystem will stimulate policymakers to reflect with open minds on the evidence and advice that scientific advisors provide and to consider getting back to them with requests for investigating further questions. Next I give an overview of the biases that can arise in the advisory process. My analysis of the ecosystem shows that careful reflection on possible biases in the science-policy process and systematic foresight thinking will contribute to higher quality scientific advice for policy. Furthermore, integrating systems thinking, foresight and bias-awareness in the scientific advisory process will ensure 'Responsible Scientific Advice' (RSA), on analogy with 'Responsible Research and Innovation' (RRI).

Methodological approach

We approach RSA on the basis of several decades of practical experience and from the following three directions:

(1) A systems analysis of the science-policy ecosystem;
(2) The literature on bias and the brain;
(3) Interviews with actors across the scientific advisory chain.

The analysis of the interviews will be the subject of another publication, which I am now preparing. In this article, we summarize the preliminary findings of the study of bias and the brain and the analysis of the science-policy ecosystem, and we consider how they inform the notion of Responsible Scientific Advice.

Results, discussion and implications

The role of scientific advisors in decision-making

Before we dig into the ecosystem, let's consider the difference between evidence-based and evidence-informed policy. 'Evidence-based policymaking' is entirely science-driven and carefully avoids ideological and other influences. It assumes that scientific evidence best serves society's needs and, so, requires sufficient time to collect it. It is sometimes considered appropriate for non-elected policymakers, given the assumption that scientific evidence is value-free. In 'evidence-informed policymaking', policymakers also seek the best available evidence, but they combine it with their understanding of social needs in making policy decisions. Evidence-informed policymaking is considered appropriate for democratically elected policymakers and when policymakers act under tight time constraints.

As Berry Tholen argues in his book *Virtue and responsibility in policy research and advice* (Tholen, 2017), it is entirely legitimate for policymakers to take their ideology and cultural setting into account, for, though the work of scientists should be value-free, politicians should not be confined to overly technocratic ways of thinking. In *The politics of evidence-based policy making* (Cairney, 2016), Paul Cairney explains that policymakers use both 'rational' and 'irrational' ways to make decisions. Rationally, they strive to gather sufficient evidence; irrationally, they rely on emotions and emotionally informed beliefs. As I describe below, a structured foresight approach combines both in the form of scientific evidence and its societal context.

One problem for policymakers arises when they have incomplete evidence or are confronted with uncertainties (Cairney, 2016; Spiegelhalter, 2017). Cairney describes persuasive communication techniques that exploit the emotional and ideological biases of policymakers in such circumstances. Spiegelhalter examines visual ways of communicating uncertainties though, as he mentions, there is limited experimental evidence on how different types of visualizations are processed and understood, and the effectiveness of some graphics depends on the audience's numeracy. He explains that, even though it is easier today than earlier to adjust visualizations to users' needs and capabilities, communicating deeper uncertainties resulting from incomplete or disputed evidence remains a challenge because when faced with uncertainty people rely largely on their unreliable gut feelings to make decisions. For this reason, emotional and cultural biases are present throughout the science-policy ecosystem.

It is crucial that scientific advisors are aware of the diverse roles they play. The ideal role is the 'Honest Broker', who puts scientific evidence in the societal context relevant to a policy question. In *The Honest Broker* (Pielke, 2007), Roger Pielke describes two models of the complicated interactions among policy, politics and science. In the 'linear model', scientists expect politicians to make evidence-based decisions; in the 'stakeholder model', they expect them to make evidence-informed decisions. Both models involve two roles that scientists can play. The linear model includes the 'Pure Scientist', who focuses entirely on research and does not interact with policymakers over how it should be used, and the 'Science Arbiter', who interacts with decision-makers by answering their inquiries on the basis of the scientific evidence while remaining as neutral as they can. In the stakeholder model, Pielke identifies the 'Issue Advocate', who formulates the scientific evidence with an eye to their political agenda, and the 'Honest Broker of Policy Alternatives', the model's only ethically acceptable role for a scientist, who takes stakeholders and society into account in formulating her scientific advice into alternative policy options. In sum, while the linear model's Pure Scientist and Science Arbiter seek to maximize policymakers' freedom of choice by serving as information resources without concern for policymakers' decisions, the Issue Advocate and Honest Broker aim to influence policymakers by providing them with explicit alternatives.

Advisors in a democracy, as in the European Parliament's STOA, tend to be Honest Brokers. Foresight methods help them to avoid the Pure Scientist's and Science Arbiter's roles by getting them to articulate the possible effects of policy on stakeholders and society. In being aware of biases in the advising process and striving to overcome them, they avoid being Issue Advocates.

Foresight as a key element in the scientific advisory process

Although foresight is often associated with the long term, foresight exploration in scientific policy advising is not so limited. Through it, we uncover possible future impact of technical and scientific developments**.** The use of foresight for anticipating consequences of decisions today is also a topic in the new book about future literacy by Riel Miller of UNESCO (Miller, 2018).

At the European Parliament, foresight investigations follow three steps (Van Woensel & Joseph, 2017):

(1) The starting point is consideration of the present scientific and technological state of the art, on the basis of which advisors brainstorm about the possible consequences of their developments in the context of a policy being considered by systematically investigating their intended and unintended effects and hard (i.e., measurable) and soft (i.e., not directly caused by a technology) impacts while envisioning society's relevant hopes and fears.
(2) Hopes and fears are then translated into a diverse set of possible scenarios, extreme rather than plausible ones, for the future.
(3) Finally, these imagined futures are analysed in terms of the policy opportunities and challenges they present.

In communicating their conclusions to the requesting members of parliament, we provide them with a 'backcast' that specifies the possible future challenges and opportunities that are relevant to the policy they are considering, and we include our legal, ethical and socio-economic reflections. We do not present these challenges and opportunities as desirable or undesirable because those judgements are for MPs' to make.

Foresight assessment of types of impact relevant for policy

Brainstorming over possible impacts can be guided by systematically posing 'what if' questions (Ravetz, 1997) or by focusing on soft impacts (Swierstra & te Molder, 2012). Soft impacts, for example, effects on health, the environment and safety, are not easy to measure or assign responsibility for. Still, as Swierstra argues in 'Identifying the normative challenges posed by technology's 'soft' impacts' (Swierstra, 2015), we cannot afford to ignore technology's soft impacts because they get more and more 'intimate' as technology further pervades our lives.

Soft impacts present their own types of normative challenges. In taking soft impacts into account in our foresight exploration, we combine Carney's (Cairney, 2016) rational and irrational forms of decision-making. We start with a technical horizon scan, a report on the techno-scientific state of the art, and combine it with stakeholders' hopes and fears. That is, we combine the scientific evidence with the societal consequences of what may occur in the future in order to put the evidence into the societal context. In both producing the technical horizon scan and envisioning possible impacts, it is important that we examine a proposed policy through different lenses, which we do by following 'the STEEPED-scheme' (Van Woensel & Vrščaj, 2015). The scheme, which is more a checklist than a methodology, specifies seven lenses though which we look at the impacts of techno-scientific developments, thereby ensuring that we cover all of the areas of interest or concern, including their national differences[1].

1. **Societal** aspects cover social and cultural values and lifestyles.
2. **Technological** aspects include the directions in which technology is developing and the diversification of its uses.
3. **Economic** aspects cover conjuncture, employment, production systems, distribution and trade systems and consumption of goods and services.
4. **Environmental** aspects pertain to the availability of natural resources, interactions with the natural habitat and impacts on our biophysical environment, that is, the planet.
5. **Political/Legal** aspects include changes in policy-making and legislative systems, including adequate current laws, laws that might need to be updated and new laws.
6. **Ethical** aspects cover individual values embedded in the society.
7. **Demographic** aspects involve looking at society as an inclusive collection of social groups defined in terms of age, gender, religion, origin, profession, education, income level etc.

In following STEEPED, we first ask the experts who we have commissioned to prepare the horizon scan to assess the evidence from these seven perspectives. Then in facilitated interdisciplinary brainstorming sessions conducted in a multi-stakeholder setting, we articulate a diverse range of opportunities and challenges that arise for different social players from the assessed techno-scientific developments.

Analysis of the science-policy ecosystem as a dynamic open system

The scientific advisory process is the way through which policymakers consider science, technology and innovation in policymaking and decision making. This advisory process is a dynamic open system, covering more than a direct science-policy interface. The overall science-policy ecosystem is complex, and a systems analysis of it into its components and their interactions is useful for unravelling its complexity. Following the work of systems analysts (Ashby, 1960; Luhmann, 1995; Schaveling & Bryan, 2018; Vickers, 1965), I analyse the science-policy interface by first considering the broader science-policy ecosystem and its wide range of societal actors. Understanding this ecosystem sheds light on the influences acting at the science-policy interface.

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[1] Earlier publications about STEEPED did not explicitly mention national differences. However, in some areas (for instance, agriculture) impacts are widely diverse nationally, which requires us to examine results through a geographical lens.

Figure 1 shows the main phases in the typical journey of scientific advice through the science-policy ecosystem. That journey starts with the identification and reframing of the question for which policy professionals seek advice. Next come inputs to the advising process, including those from the scientific community and special interest and pressure groups seeking to influence public policy (e.g., think tanks, interest groups and 'merchants of doubt'[2]), and the 'throughput', i.e., the process by which scientific advisors employ foresight exploration to contextualize the scientific evidence socially and translate it into policy options that they communicate to policymakers. Figure 1 also illustrates the communication pathways among the interface's subsystems, including a 'feedback loop' from policymakers to advisors, by way of which for the conclusions of the research are reviewed against the original request for advice to ensure that they satisfy it. Feedback can also come from policymakers when they lack evidence or encounter contradictory evidence.

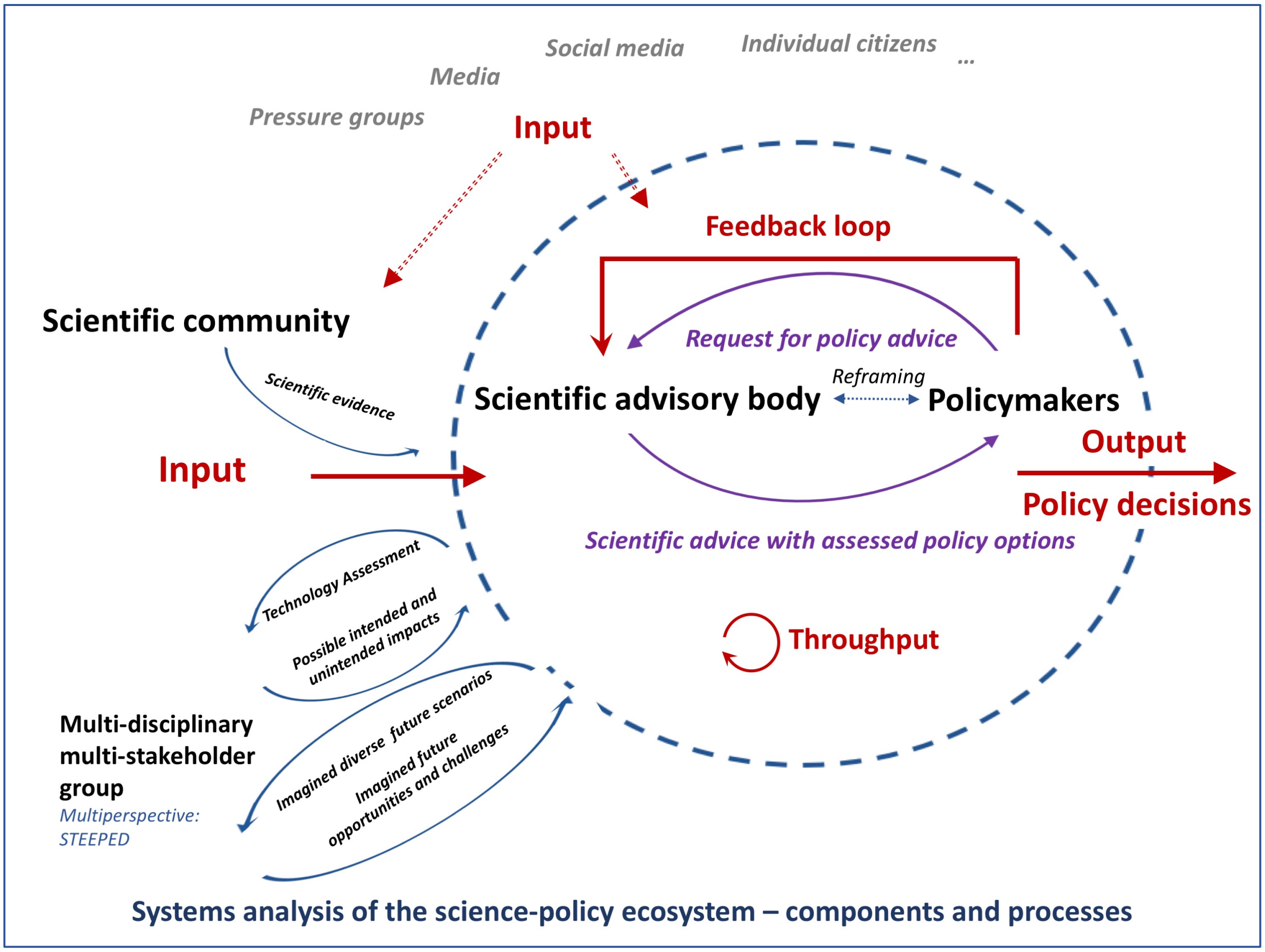

Figure 1. The science-policy ecosystem

Figure 1 depicts what Luhmann calls an 'open system', i.e., one in which the broader society exerts influence. The open system's most relevant actors are:

- The research community;
- Scientific advisors;

[2] 'Merchants of doubt' are skillful at confusing actors, even scientists. See Oreskes's and Conway's book (Oreskes & Conway, 2010) and the related movie.

- Policymakers;
- Special interest and pressure groups;
- The media, both mainstream media, such as newspapers, radio, television and their digital versions, and social media;
- Individual citizens.

Figure 2 is an alternative analysis of the science-policy ecosystem, emphasising inputs, throughput, outputs and the feedback loop. It also summarizes the roles of the subsystems by abstracting away the communication paths-pathways.

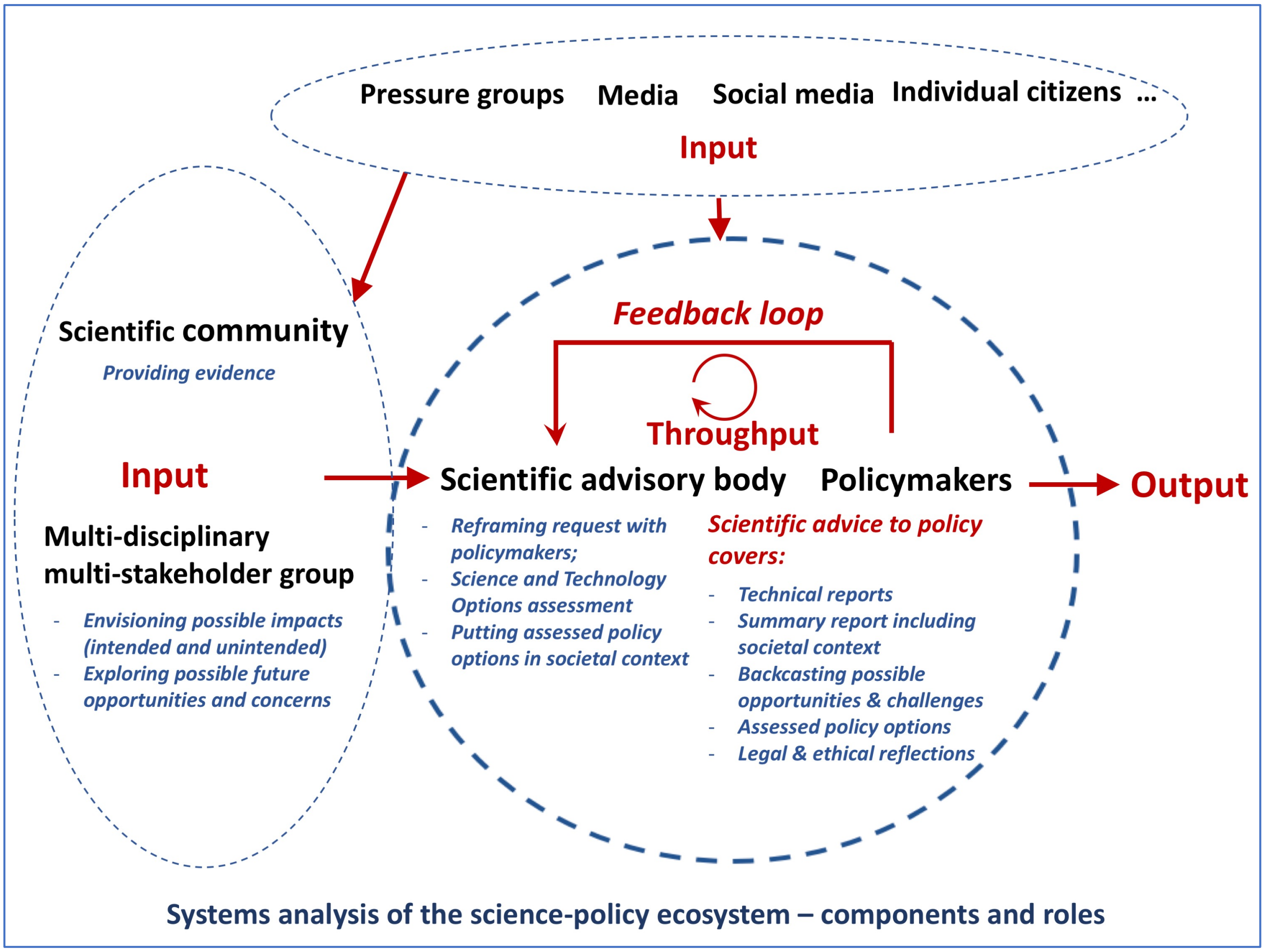

Figure 2. The science-policy ecosystem – the components and their roles

The power of systems analysis

Scientific advisors ideally should apply systems thinking at several points in the advising process. In a world of ever-increasing specialization, thinking in systems terms reinforces the move from reductionism to holistic thinking, while acknowledging the unity of reality and the interconnections of its parts (Boswell, 2018; Frodeman, Klein, & Pacheco, 2017; Strijbos, 2017).

Transdisciplinarity in the scientific advisory process

The Oxford Handbook of Interdisciplinarity (Frodeman et al., 2017) describes unidisciplinary research as work on a scientific problem conducted by researchers from the same discipline working independently. It describes three types of cross-disciplinary integration: (1)

multidisciplinarity, in which researchers from different disciplines work sequentially on a scientific problem; (2) interdisciplinarity, in which researchers from different disciplines work independently but integrate their theoretical approaches and methods to some degree while remaining anchored in their disciplines and (3) transdisciplinarity, which involves the greatest degree of cross-disciplinary integration and extension beyond disciplines to create new approaches to the problem. In *The Virtual Weapon* (Kello, 2017), Lucas Kello formulates a similar classification for cyber-theoretic research.

During his STOA Chairmanship from 2014-2017, Paul Rübig (*STOA Annual Report 2016*, 2017), Member of the European Parliament, emphasised the importance of systematically integrating what he calls a 'silo and pipe strategy' in STOA's work and its information flows, identifying the communities, or silos, generating and receiving information and the channels, or pipes, through which they share information. I recommend transdisciplinary pipes to link the silos throughout the scientific advisory process. That is, researchers from different disciplines should work together to develop a systems analysis of the problem for which advice was requested, synthesizing their frameworks and methods to transcend their disciplines and create new approaches to the problem.

What are biases and what types occur in the science-policy ecosystem?

Biases, which can be either implicit and unconscious or explicit and conscious, involve a failure of objectivity, neutrality or open-mindedness. They can be explained as shortcuts in our brains that lead to non-objective decision making. In the context of scientific advice, the most relevant biases are **cognitive**, which cause us to make inaccurate interpretations and inappropriate decisions. To understand how to avoid cognitive biases, we have to understand how they occur.

- One of the most relevant cognitive biases is **confirmation bias**, the tendency to acknowledge only information that confirms a belief or hypothesis. For example, someone wants to challenge the climate change hypothesis according to which it is anthropogenic, pays attention to evidence confirming her or his belief and ignores contrary evidence.
- **Knowledge bias** is the tendency to ignore facts that one does not understand. It occurs in policy discussions because of policymakers' and citizens' varying scientific literacy.
- The **blind spot bias** occurs when one does not realise one's own biases and, so, does not consider all of the available options in decision making. Similar to the blind spot bias is the **focusing bias**, in which one puts too much emphasis on one factor at the expense of others.
- The **anchoring bias** is the tendency to over-emphasize the first piece of information one receives.
- The **ideological bias** results from one's implicit values.
- The **tactical bias** is the conscious choice to ignore evidence to further one's objective.
- The **funding bias** is the tendency to support the interests of one's financial sponsor.
- Scientists and peer reviewers fall prey to the **publication bias** when the likelihood that they submit or accept a study for publication is influenced by the study's results. (Brown, Mehta, & Allison, 2017).
- **Media biases** influence the selection of what is broadcast.
- Relatively unconscious **implicit biases** are expressed in automatic prejudiced judgments. In the scientific context, implicit biases occur largely in clinical research.

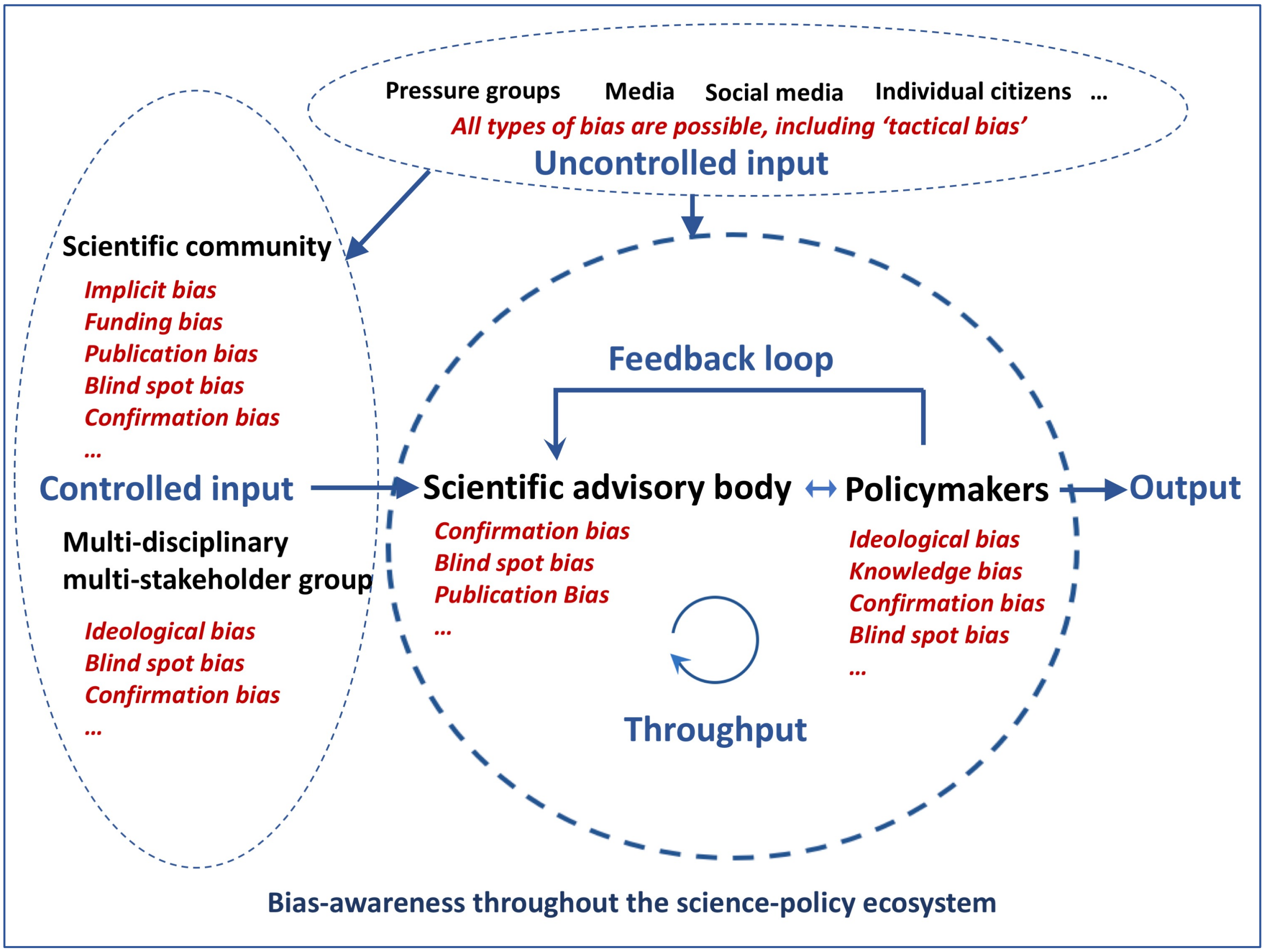

Figure 3. The most common biases in the science-policy ecosystem

Biases and the brain

In *Thinking Fast and Slow* (Kahneman, 2012), Daniel Kahneman provided a simplified description of the brain's main cognitive processes in terms of two 'systems' for thinking. System 1, the fast thinking system, is intuitive and automatic; System 2, for slow thinking, requires attention and effort. The two systems interact. When the fast system encounters a problem, one can switch to the slow system and reflect carefully. On the assumptions that the 'law of the least effort' applies to human thinking and slow focused reflection costs considerably more in effort, fast intuitive thinking should dominate. Theo Compernolle (Compernolle, 2014) calls the former the 'reflecting brain' and the latter the 'reflex brain'. According to him, the reflecting brain is responsible for conscious reflecting; logical, analytical and synthetic thinking and thinking ahead, among other things. The reflex brain comes to conclusions more quickly and makes a lot of irrational mistakes. Biases arise in the reflex brain more often than in the reflecting brain.

In an earlier paper (Kahneman & Klein, 2009), Daniel Kahneman and Gary Klein concluded that judgements based on intuition and subjective experience are not reliable.

In *The enigma of reason - a new theory of human understanding* (Mercier & Sperber, 2017), Hugo Mercier and Dan Sperber argue that we use reason mostly in our interactions with others to produce arguments convincing them to think and act as we argue they should.

Assuming that all of these theories have some truth in them, how can we use them to improve scientific advice and policymaking? We should find ways to induce slow thinking, especially reflective thinking about biases, in the science-policy ecosystem's key actors, in particular policymakers and scientific advisors.

Possible ways to overcome biases in the policy advisory process

Avoiding bias is important in policy advising. So, scientific advisors should carefully monitor possible biases when undertaking a systems analysis of the question they have been handed.

There are ways to overcome some biases. For instance, (Brown et al., 2017) argue that meta-analyses can decrease publication bias by including dissertations with peer reviewed literature. For the blind spot bias, scientific advisors can systematically include cross-analyses of assessed policy options and their impacts on other policies. Strategic scenario planning (Ramírez & Wilkinson, 2016) can guide advisors in developing concise though wide-ranging sets of options for policymakers to consider. For the knowledge bias, scientific advisors can communicate their advice at different technical levels and in both textual and visual formats, as is already often the practice.

In general, advisors and policymakers should become aware of biases, deliberately slow their thinking down and challenge themselves and each other to reconsider their assumptions, inputs, conclusions and decisions. Active critical thinking is crucial.

Conclusions

Bias awareness, foresight processes, systems analysis and feedback loops in the science-policy ecosystem are the basic elements to ensure 'Responsible Scientific Advice' (RSA) on analogy with 'Responsible Research and Innovation' (RRI).

The inclusion of foresight in the scientific advisory process and the systematic reframing of requests for policy advice ensure that the principles of Responsible Research and Innovation (RRI) are followed in the scientific advisory process for policy purposes.

Combining the features of RRI described by Jack Stilgoe (1 to 4) and Richard Owen (5) (Owen, Macnaghten, & Stilgoe, 2012; Stilgoe, Owen, & Macnaghten, 2013), a framework for RSA should cover:

1. **Inclusion**: ensured by the "D" in "STEEPED";
2. **Anticipation**: included by looking into intended and unintended possible future impacts;
3. **Reflexivity**, i.e., reflection: included by looking into possible biases;
4. **Responsiveness**: covered by evaluating how well the outcome fulfils the request and reframing the request if necessary
5. **Democratic governance**: aided by the transparency of the scientific advisory process.

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