Scientific Advice Mechanism

Scoping paper

Making sense of science

under conditions of complexity and uncertainty

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Introduction

Science has been transforming our daily lives. Vaccination programmes based on innovative basic life sciences, for example, have had enormous global health benefits. Reliable engineering, based on solid physical and chemical science, has revolutionized how we travel, communicate or access information. Advances in physics have pushed our understanding of the universe to new frontiers. Behavioural insights, based on behavioural economics and psychology, have been successfully used to nudge humans towards healthier, financially more advantageous, and environmentally more sustainable choices.

Science, understood in the broad sense as a body of knowledge accumulated through systematic and logical rules of research, remains the best-suited source of evidence to inform policymaking (while politics may also draw other possible sources of information, such as personal experience, popular opinion, or anecdote). Despite its inherent challenges, science "comes closest to an ideal described as 'speaking truth to power'"[1].

Scientifically-informed evidence used at the right time can save lives, help to foresee environmental disasters and address major social problems. Conversely, ignoring robust evidence may have far-reaching negative consequences. As an example, a more rigorous review of the scientific evidence in the 1970s on the sudden infant death syndrome could have prevented at least 60,000 infant deaths[2]. In South Africa, the president's "personal scepticism towards … viral theory of HIV-AIDS slowed the delivery of anti-retroviral drugs to the country's more than 5 million AIDS-infected persons"[3]. A climate policy informed by interest groups who construct doubt on the scientific consensus regarding human-made climate change, including through purposeful misinterpretations of the nature and scale of scientific uncertainty related to that change[4], would have disastrous and irreversible consequences for our planet.

However, using scientifically established evidence may lead to failed policies, e.g. if the empirical findings are not relevant to the circumstances at hand or if their generalisability is wrongly interpreted. One example is the World Bank's 1995 Bangladesh Integrated Nutrition Project (BINP), which was to improve the nutritional status of pregnant and lactating women, and their infant children, in poor communities. The World Bank found no significant impact of BINP, even though the design drew on the acclaimed and successful Tamil Nadu Integrated Nutrition Project (TINP), with confirmed evidence of its effectiveness. Wrong predictions were made about BINP impact based on observations of success elsewhere[5].

Science advice is used both in short-term emergencies and to inform policy on medium/longer-term challenges. Science advice to policy is integral to the development of many regulations which

[1] See e.g. Jasanoff, S. (2011) "Quality control and peer review in advisory science", in. Lentsch, J. and P. Weingart (2011) (eds.) *The Politics of Scientific Advice. Institutional Design for Quality Assurance*. Cambridge: Cambridge Univeristy Press, p.19.

[2] Gilbert, R. et al. (2005) "Infant sleeping position and the sudden infant death syndrome: systematic review of observational studies and historical review of recommendations from 1940 to 2002". *International Journal of Epidemiology* 34(4): 874-887. Quoted in Parkhurst, J. (2017) *The Politics of Evidence. From Evidence-Based Policy to the Good Governance of Evidence.* London and New York: Routledge. https://www.taylorfrancis.com/books/9781317380870

[3] Jasanoff, S. (2011, p. 20).

[4] See e.g. Oreskes, N. and E. Conway (2011) *Merchants of Doubt. How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London: Bloomsbury Publishing.

[5] Cartwright, N. and J. Hardie (2012) *Evidence-Based Policy. A Practical Guide to Doing it Better.* Oxford: Oxford University Press, pp. 80-84.

safeguard human health and safety, and the environment. The approval of drugs both for humans and animals requires a wide range of scientific tests before a drug can be put on the market. Such regulatory science advice also plays a decisive role when it comes to the approval of plant protection products or of plant varieties obtained through genetic modification. Other examples of the systematic use of science advice are weather forecasts, combating the spreading of infectious diseases or the monitoring of seismic and volcanic activity.

Challenges

In a world which is becoming more and more complex, an increasing number of problems are cutting across disciplines, across analytic levels and across geographic regions. Science-informed advice to policy can provide a credible and reliable approximation of the actual impact of policy decisions. It is the task of science advisors to identify and integrate the most relevant and robust evidence from various disciplines, sources and approaches, to make sense of it and to translate it for policymakers. However, the task of making sense of science and of providing good evidence-informed advice for policy involves various challenges.

Firstly, the **complexity** of many policy issues for which science advice is sought may require evidence coming from several disciplinary fields, from technical and natural sciences to social sciences and the humanities. Each discipline, with its own set of approaches and methods, produces a specific type of evidence including the identification of different causative factors. This may result in multiple views rather than a single, cohesive and unambiguous "scientific viewpoint", regardless of how much research scientists perform[6].

Secondly, policy-makers and citizens expect conclusive statements from science. Often, this is possible. However, there are also many areas where scientific evidence can be complex, controversial, ambiguous and characterised by uncertainty. Scientists use theories and models to analyse the empirical world and capture its complexity in the best possible way. These theories and models evolve and become more refined in the light of new knowledge. Additional research can produce more knowledge and improve our understanding of reality. At the same time, new research can also unveil new knowledge gaps and sources of uncertainty. Scientific uncertainty, ignorance and indeterminacy are, therefore, elements in our comprehension of the empirical world[7], though to varying degrees depending on the subject matter. Note that uncertainty is also "a powerful incentive in the striving for more knowledge" and ambiguities "do not mean that everything becomes fuzzy and porous or that anything goes"[8].

A part of the uncertainty of scientific evidence stems from issues related to the **reproducibility of scientific results**, the reasons for which may include different types of **bias in doing science**[9]. For instance, bias can result from a lack of statistical power, in particular in complex issues, but may also

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[6] Slob, M., & Staman, J. (2012). *Policy and the evidence beast - A Dutch study of the expectations and practices in the area of evidence-based policy*. (R. Instituut, Ed.). The Hague: Rathenau Instituut

[7] Jasanoff, S. (2007). "Technologies of humility". *Nature*, *450*(1), 33. Retrieved from http://www.nature.com/articles/450033a

[8] Nowotny, H. (2016) *The Cunning of Uncertainty*. Cambridge: Polity.

[9] Fanelli, D., Costas, R., & Ioannidis, J. P. A. (2017). "Meta-assessment of bias in science". *Proceedings of the National Academy of Sciences*, *114*(14), 3714–3719. http://doi.org/10.1073/pnas.1618569114

be systematically introduced by the way science is commissioned, conducted, reported and used. Bias can also arise from how scientists are incentivised to conduct research: actively searching for a particular outcome rather than performing balanced hypothesis testing, along with the tendency not to publish 'negative' or 'non' results[10]. Although science is mostly "self-correcting", in the sense that important findings will be inevitably taken up by others and exposed to careful scrutiny, the timescales for correction may be long in some fields, and the efficacy of self-correction may also depend on its social and institutional context[11]. In addition, scientists also often lack incentives to perform replication studies. The challenge of reproducibility is being addressed within policy for science, e.g. through a set of strategies to improve research practices, funding decisions and governance in those areas[12].

Translating evidence to policy

Where uncertainty of scientific evidence and the complexity of policy is a major issue, policy-makers are often faced with the question of which evidence or scientific opinion they should base their decisions and different, sometimes contradictory policy responses may result from the type of evidence by which their decisions are ultimately informed. There may also be confusion among policy-makers between the **internal validity and robustness** of a body of evidence, and its **external validity (generalisability).** Thus, the appropriateness of scientific evidence becomes a central concern for policy-making, in addition to its quality. Parkhurst defines **appropriate evidence** as "that which speaks to the multiple social concerns at stake in a policy decision, which is constructed in the ways that are most useful to achieve policy goals, and which is applicable to the local policy context"[13]. "**Good evidence for policy**" is subsequently defined as "evidence which is appropriate … and which further **meets high-quality standards from the scientific perspective**".

One major problem in providing "good evidence for policy" are the political evidentiary **biases** which may be at work, particularly in situations of complexity, uncertainty and conflicting policy priorities. One type is **"issue bias"**, whereby "evidence utilisation can shift the political debate to particular questions or concerns in a non-transparent way"[14]. For instance, political attention can be diverted to issues where less uncertainty exists, or to issues for which evidence can be obtained by particular methods (often experimental methods such as randomised controlled trials or meta-analyses, commonly placed at the top of the various existing "hierarchies of evidence"[15]), at the expense of other valid concerns at stake. Another type of bias, i.e. **"technical bias",** may be introduced when evidence is created, selected or interpreted for policy-making in a way that does not follow principles

[10] Boyd, I. (2013). "A standard for policy-relevant science". *Nature*, *501*, 159–160. http://doi.org/10.1038/501159a

[11] See e.g. Romero, F. (2016) "Can the behavioral sciences self-correct? A social epistemic study". *Studies in History and Philosophy of Science Part A*, 60, pp. 55-69. https://doi.org/10.1016/j.shpsa.2016.10.002

[12] See e.g. Koninklijke Nederlandse Akademie van Wetenschappen (2018) "Replication studies. Improving reproducibility in the empirical sciences. Advisory report". https://knaw.nl/en/news/publications/replication-studies/@@download/pdf_file/20180115-replication-studies-web.pdf

[13] Parkhurst, J. (2017)

[14] Ibid, p. 8.

[15] Nutley, S., Powell, A. & Davies, H.(2013). "What counts as good evidence?" London: Alliance for Useful Evidence. https://research-repository.st-andrews.ac.uk/bitstream/handle/10023/3518/What_Counts_as_Good_Evidence_published_version.pdf?sequence=1&isAllowed=y

of scientific best practice[16]. Other than cases of overt biases, such as purposeful "cherry-picking of evidence", often motivated by advocacy of a preferred political option, such bias may be more subtle and result from errors in analytical thinking (e.g. incorrect causal assumptions) and in judgement under uncertainty. Controlling and reducing political evidentiary bias may often need to start at the stage of formulating questions for which policymakers request science advice.

In the policy and regulatory fields, **uncertainty analysis** is subject to debates at both European and international level. Important reviews and guidance documents have been issued by individual researchers as well as European agencies – e.g. by the European Food Safety Authority (EFSA) and through the EU Agency Network for Scientific Advice (EU-ANSA) – and international organisations such as the OECD. Different concepts of "scientific uncertainty" are used in particular by different scientific disciplines as pointed out in the document "Approaches to assess and manage scientific uncertainty: examples from EU ANSA Agencies" (forthcoming) drafted by representatives of the agencies in the network. Lofstedt and Boulder[17] call for a profound academic discussion on uncertainty analysis in the European policy context, possibly through an international scientific summit focusing on best practices of uncertainty analysis.

In the policy and regulatory context, the concepts of hazard and risk are regularly used, next to that of uncertainty. **Hazard** is commonly defined as a property or situation with the potential to cause harm. **Risk** is commonly defined as a combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of the damage or injury caused by this (risk = exposure x hazard).

While both uncertainty and risk are crucial to policy-making, the two concepts as well as the difference between the two, are not always fully understood by the public and by politicians. The way in which risk and uncertainty are presented to the policymakers and communicated to the public is of fundamental importance both for policymaking and for **public risk perception and acceptance**[18].

In some contexts, policymakers may be driven by very high risk aversion and/or their perception of the public's opinion. This may lead to policy or regulatory decisions that are precipitous and/or not fully consistent, or which raise tensions between caution on the one hand and potentially foregone benefits on the other (including benefits for health and environment, but also costs of missed opportunities). The scope for further applying **risk-benefit analyses** in policy decisions in view of uncertainty and risk is a subject for exploration. One example of EU legislation which draws on the concepts of risk-benefit analysis as well as communicating risks and benefits to the public (rather than risks only) is the 2012 Biocides Regulation[19].

Communication is an important dimension of the science advice itself too. An OECD report acknowledges that "the impact [of science advice] depends on how it is formulated and

[16] Parkhurst (2017, p. 42).

[17] Lofstedt, R., & Bouder, F. (2017). "Evidence-based uncertainty analysis: What should we now do in Europe? A viewpoint". *Journal of Risk Research*, *9877* (May), 1–20. http://doi.org/10.1080/13669877.2017.1316763

[18] See Lofstedt and Bouder (2017) for the European context. See also e.g. Kahneman, D. (2011) *Thinking, Fast and Slow*. London: Penguin, 334-341, for a broader discussion of the effect of risk framing on human perception and choice.

[19] Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0528&from=EN

communicated as well as how it is perceived by its target policy audience and by other interested parties"[20].

The European policy context

Under President Juncker, the EC has committed to put better regulation principles and scientific evidence at the heart of policy-making since "policy making requires robust evidence". It is argued that "High quality scientific advice, provided at the right time, greatly improves the quality of EU legislation and therefore contributes directly to the better regulation agenda"[21]. To this end, the EC established the Regulatory Scrutiny Board[22] and the Scientific Advice Mechanism's High Level Group of Scientific Advisors (SAM HLG) in 2015.

The choice of an independent collective science advice body (SAM HLG), supported by the EC-hosted SAM Secretariat, aimed to ensure a greater subject expertise and diversity of views among members, and provide them with adequate support resources. At national level in the EU, four types of science advice structures exist, often in combination: high-level advisory councils; specialised advisory committees; national academies, learned societies and networks; chief scientific advisors or CSAs (in the UK now complemented by department scientific advisors or DSAs for each government department)[23]. At the EU level, many specialised decentralised agencies and expert committees continue to exist in parallel to the SAM HLG.

SAM HLG has access to the expertise of European academies (through the Horizon 2020-funded project Science Advice for Policy by European Academies) as well as to in-house expertise found notably in the Joint Research Centre (JRC). JRC's work includes the "EU Policy Lab" performing cross-cutting activities such as: policy impact assessment studies; embedding behavioural insights into the EU policy cycle and modelling activities producing data to allow policy-makers to assess the benefits and disadvantages of possible policy scenarios[24]. As part of its cross-cutting actions, JRC carries out foresight studies to anticipate future societal challenges and has organised a major conference (2017) "EU for Facts: Evidence for policy in a post-fact world"[25].

The task of the SAM HLG is to provide the EC with independent science advice on specific policy issues where such advice is critical to the development of EU policies or legislation and does not duplicate advice being provided by existing bodies. The advice provided by the SAM HLG identifies the most important and relevant evidence that can support decision-making on the specified policy issues, including an assessment of the robustness and limitations of the evidence.

The SAM HLG also provides recommendations for improving the overall interaction between Commission policy-making processes and independent science advice concerning any field of Union

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[20] OECD (2015) “Scientific advice for policy making: the role and responsibility of expert bodies and individual scientists”, *OECD Science, Technology and Industry Policy Papers,* No. 21, OECD Publishing, Paris, p.5. http://dx.doi.org/10.1787/5js33l1jcpwb-en

[21] European Commission. (2015a). Commission Decision on the setting up of the High Level Group of Scientific Advisors - C(2015) 6946 final. http://ec.europa.eu/research/sam/pdf/c_2015_6946_f1_commission_decision_en_827417.pdf#view=fit&pagemode=none

[22] European Commission. (2015b). Decision of the President of the European Commission. https://ec.europa.eu/info/sites/info/files/decision-on-the-established-of-an-independent-regulatory-scrutiny-board_may2015_en.pdf

[23] For a fuller overview see e.g. OECD (2015) , p. 13-16.

[24] https://ec.europa.eu/jrc/en/research/crosscutting-activities

[25] https://ec.europa.eu/jrc/en/eu4facts

policy making. The present topic is thus relevant for all policy areas which make use of scientific evidence and science advice.

Questions to be addressed by SAM HLG

SAM HLG is asked to provide by July 2019 guidance on the effective and transparent provision and use of science advice for informed policy-making, considering the complexity and uncertainty of contemporary issues and science. The guidance to be delivered by SAM HLG will inform the way in which science advice to policy-making will be provided in the next European Commission (post 2019-2024).

It shall inform in particular the following question:

1) *How to provide good science advice to EC policymakers, based on available evidence, under conditions of scientific complexity and uncertainty?*

Target audiences

The opinion will be primarily addressed to:

- members of the College of Commissioners making use of high-level science advice on major cross-cutting policy issues;
- specialised bodies providing scientific advice in the EC, and EC policy services making use of the advice;
- Regulatory Scrutiny Board (RSB);
- the architects of the future system of science advice governance in the Commission;
- high-level bodies to provide science advice to the next Commission.