Charting science advice at local, national and international levels

UCL STEaPP launch an empirical framework-building project helping practitioners work towards more successful and appropriate science–policy interactions.

April 24, 2015.

The importance of science advice—broadly defined here as practices involving individuals, organisations and structures that mobilise natural and social scientific and engineering knowledge into public decision-making—to decision makers is becoming ever more salient. Difficult issues including but unfortunately not limited to climate change, future energy, risk management, equity and quality of public services, food security and data governance have already made their way to the forefront of local, national and international political agendas. Calls for 'science-based' or 'evidence-informed' policies can be heard across political and regional spectrums. Facilitating and understanding knowledge and providing access for science-based information to enter political decision-making are seen as essential for enhancing the quality of policy-making, although it is key to recognise that many of these 'wicked' problems react poorly to conventional management, solutions and panaceas, which can do more to hinder than to help the situation. Against this backdrop, both the number and types of structures and mechanisms through which science-based policy advice is provided has increased. The relationship between science on one side, and policy and politics on the other, is not a simple one.

The Department of Science, Technology, Engineering and Public Policy (*UCL STEaPP*) at University College London is starting a project with the aim of contributing to rigorously acquired, practical advice in this field that can aid those working at or near the boundary of science and policy. *UCL STEaPP*'s mode of research focusses working hand-in-hand with practitioners to ensure that knowledge generated is both effective on-the-ground, and addresses real-world questions and challenges. This *UCL STEaPP* project aims to pave the way for a longer-term research group on innovating practices of science advice. The substantive need for this arises from two frequent questions from science advice practitioners to scholars in this field: i) What evidence do you have to help me do my job better? ii) How would you set up effective science advisory mechanisms in my context? To answer this question also requires careful consideration of how 'success' can be understood both in individual cases of science advice, and across them.

Recent developments constitute an opportune starting point for further research into the role of science advice in policy. The new *International Network for Government Science Advice* (INGSA) has created and continues to foster valuable links between and within policy, practice and academia around the structures and use of scientific advice. The recent *OECD Global Science Forum Report on Scientific Advice for Policymaking* (published on 23 April 2015) highlights the attention that is being directed to this area. While these developments are wide reaching, there are knowledge gaps to be explored including parliamentary advice; engineering advice; roles of 'boundary organisations' (e.g. IPCC, PBL, What Works Centres); roles of NGOs and think tanks; technical advice; influence of topical domains; influence of levels of development; advocacy roles; operational vs. agenda-setting roles; 'top' advisors such as CSAs compared to more specific (Chief Medical Officer, Chief Economist) and lower levels of engagement; science advice at local and international levels; internal structures of delivering and receiving advice; capacities for dealing with the advisory process; mobilising and incentivising science and engineering communities; and issues of accountability, quality, communication and participation.

Academic work relevant to the field of science–policy interactions is located across disciplines, each

with (sometimes very) different theoretical lenses and research methods. Given that the scopes of both science and policy respectively are so broad, this is not only understandable, but thoroughly appropriate. The *UCL STEaPP* science advice project aims to distil these knowledge domains into a framework which, when used to compile and study a variety of empirical cases, can help to explore constellations and patterns that may reveal new advice that can be provided to science–policy practitioners. The framework should play a role in both facilitating further research and acting as an increasingly comprehensive source of knowledge for those who seek an answer to the two guiding questions. The project also has a networking function, connecting both research and researchers concerned with this issue.

Despite the broad range and styles of work, there are some aspects of science–policy interactions that we now know are important to consider. The following aspects are not comprehensive and do not in themselves constitute a proposed framework, but instead are intended to give a flavour of the feasibility of this idea, complementing and adapting reviews and understanding built up across relevant fields (Oliver, Innvær, et al. 2014; Spruijt et al. 2014). Significant overlaps can inevitably be discerned, but this is intentional, given the aim to structure varied and messy empirical sources.

Understanding the **type of issue** faced by decision-makers is important, although there are different possible frames to use. Issues can be somewhat classified using uncertainty and its sources (Funtowicz and Ravetz 1993; Hoppe 2010; Morgan and Henrion 1992), value consensus (Pielke Jr 2007; Hoppe 2010) and structure of belief distribution (Sabatier and Jenkins-Smith 1993), decision stakes (Funtowicz and Ravetz 1993), and potential for unforeseen consequences (Jasanoff 2009; Sarewitz 2011), among other characteristics.

Advisory structures are also an important differentiating factor. Jasanoff (2011) considers how particular institutional structures arise from different national constructions of legitimacy, distinguishing between advisory bodies, embodied experts and bodies of knowledge. The forthcoming OECD report, *Scientific Advice for Policy Making: the Role and responsibility of expert bodies and individual scientists* posits that science advisory structures are usually mixtures of statutory mandated committees, permanent or ad hoc technical advisory structures, academic institutions and individual advisors. Lentsch and Weingart (2011) take a more general approach, distinguishing collegial bodies, hierarchical, research based organisations, and academies. Descriptions of advisory structures could also be extended to include incentive structures, where they can be discerned. Literatures on the motivation of officials (Niskanen 1971; Dunleavy 1991) and their behavioural responses to objectives and incentives (Lipsky 1980; Bevan and Hood 2006; Le Grand 2003) play a role here. Important literatures on 'boundary organisations' (Guston, Clark, et al. 2000) which both straddle and contribute to defining the perceived line between science and policy, and provide a useful foundation to build upon. Advisory structures may also differ both between parts of the world and within an organisation with respect to what they are trying to achieve (Clark, Tomich, et al. 2011). Nevertheless, cases such as the Netherlands Environmental Assessment Agency's (PBL) experience building and implementing guidelines around the concept of post-normal science (Petersen et al. 2011) illustrate that some institutional isomorphism (DiMaggio and Powell 1983) around contemporary ideas of science–policy good practices could help structure useable, empirical institutional typologies.

Broader **management and orchestration**, governance and—where needed—reform of advisory structures is important but often overlooked.. These arrangements operate in a dynamic environment where competition and co-ordination are likely to play important roles, and some reports have already focussed on these wider surroundings and dynamics (e.g. Doubleday and Wilsdon 2013). Advice systems differ between broadly different styles of government, such as between parliamentary and presidential systems (Halligan 1995). Policy areas seem to matter strongly too. Co-ordination is necessary when in situations where structures overlap—referring to where domains are considered relevant to many structures and mechanisms—and when they 'underlap'—when problems lie outside existing competences (Wegrich and Stimac 2014). Management in advice structures must be an active process, especially given the changing nature of the reputation and status of competing sources

(Yaniv and Kleinberger 2000). There is significant overlap with culture and context (see below) in this area, which is hard to avoid, and it should be noted that important differences in management and regulatory styles can be discerned both geographically (Jasanoff 2005) and by policy sector (Halffman 2005).

As well as advisory structures and the dynamics they are embedded in, the **characteristics of the recipients of advice** also are likely to play a role. Many decision-makers, while increasingly acknowledging the limitations of science, still ask more and more of it—a point noted by van Asselt and Vos (2006) in relation to the precautionary principle. Bureaucrats also appear to use and relate to advice in different styles Page (2010), although this is an area that could benefit from more empirical study. Another literature has highlighted that low statistical skills present high barriers to using evidence effectively, even among highly trained segments of the population (Gigerenzer et al. 2007). Nichols (1972) observed that the 'quality' of the recipients play a considerable role in determining the effectiveness of science advice, and to this day it is probably fair to say that in much of the relevant scholarship, the characteristics of the recipient often take a backseat to the characteristics of the adviser.

Skills and characteristics of advisors are also likely to be of importance. For example, advisors who can transcend disciplinary and cultural boundaries and synthesise knowledge from several fields and perspectives, as well as being aware of the practical limitations, are often thought to be the most valuable in the face of complex problems (Jasanoff 1990; Verweij et al. 2006; Lebel et al. 2004). Scientists without these qualities may underestimate the importance of discussion and negotiation in their contexts. Important interactions exist between advice structures and advisor characteristics—for example, advisors at different levels of government display different characteristics as results of both demands on them and structural reasons, such as hiring practices (Howlett and Newman 2010).

It also appears that beyond skills and structures, **activities of advisors and recipients** are important, and both cannot be seen as unitary structures. (Clark, Tomich, et al. 2011). The receptivity of recipients to science advice varies, and why and how these and other variations exist could benefit from empirical work attempting to shine some light here. A wide array of recipients and potential recipients perform different activities throughout the policy cycle, and understanding what drives their assessment of produced and provided knowledge in different venues and formats and at different times has been identified as a key remaining gap in the literature on evidence-informed policy (Oliver, Lorenc, and Innvær 2014). Some literature has already made empirically grounded headway in discerning different styles and activities in policy analysis, such as the model of Mayer, Daalen, and Bots (2004) illustraing six archetypal policy activities, or the work of Page (2010) indicating that bureaucrats can operate in modes of experts themselves, mobilisers of expertise, receivers of expertise or simply as intermediaries. Given that those asking questions have significant power in framing their response or answerability (Weinberg 1972; Stone 1997), it is important to not simply picture science advice as an 'exchange' but as a much more nuanced set of interactions, incentives and constraints. Indeed, it is not unusual to see traditional scientific advice structures offer unsolicited advice, seemingly often as part of a longer-term strategy relating to reputation rather than a one-off transaction (Hilgartner 2000).

The **type of knowledge** advisory structures possess or can generate is also of interest. Many ways to approach this exist, although most involve examining either input, output, or process measures (Clark and Majone 1985), and no approach is fully comprehensive. Using a lens of 'expertise', it is possible to distinguish between *scientific expertise* about abstract concepts and their relations, *policy expertise* about past, present and proposed instruments, *process expertise* about the process of policy-making and *instrument expertise* about what makes permissible law (Page 2010). Some advisory structures generating and transmitting knowledge may deliberately include civil society views, for both normative or instrumental reasons (Guston and Sarewitz 2002; Schot and Rip 1997), with the latter stemming from a tension between the production of standardised, universal knowledge, and knowledge integrating the world's local variation and complexity (Callon 1999). Building knowledge in this way is often captured using the idiom of 'co-production' (Jasanoff 2004), which itself has a range of versions (Lövbrand 2011). Co-production has been used to mean both a de-

scriptive way to view and analyse processes of making meanings, decisions and knowledge across scales, and a prescriptive or normative concept to be used to manage and enhance projects or programmes (van Kerkhoff and Lebel 2015). Knowledge type and its construed use can also not be seen in isolation from the characteristics of the problem faced (Turnhout, Hisschemöller, and Eijsackers 2007; Michaels 2009). In addition, one branch of relevant literature has suggested that knowledge products are not distinguished intrinsically, but more operationally in terms of criteria of salience, credibility and legitimacy (Mitchell et al. 2006).

Methods of communicating and disseminating advice are likely to affect its interpretation and uptake. Narrative stories representing dynamics of change and power are the primary approach for defining and contesting many policy problems (Stone 1997), and scientific advice must often take a tactical response to being "dropped into contexts that have already been conditioned to produce distinct cultural responses to scientific claims" (Jasanoff 2010, p. 240). Scientific advice itself can also form new theoretical 'myths'—such as those of equilibrium or resilience (Timmerman 1986). At perhaps a more superficial level, psychological literatures have highlighted interpretation problems with regards to probability, where incorrect inferences can be made both from confusing it with similarity (Tversky and Kahneman 1982) and from the presentation of probabilities in relative form, rather than as natural frequencies (Hoffrage et al. 2002). The way that logically equivalent situations are framed can change resulting preferences, especially if reference points or the salience of different outcomes are altered (Kühberger 1998). While displaying risk and uncertainty graphically can both assist in interpretation and grab people's attention (Lipkus and Hollands 1999), charts and presentations can also contain features with the potential to significantly mislead viewers (Tufte 1983; Tufte 2006). Verbal communication of uncertainty using terms like *likely* or *extremely likely* allow fluidity but are variably interpreted. Organisations such as the IPCC have attempted to create consistency in this area (IPCC 2005), while some organisations have attempted to make broader guidance in communicating uncertainty (e.g. PBL Netherlands Environmental Assessment Agency 2014).

A range of work highlights the importance of the **culture and context** in which a science–policy interaction is situated. Jasanoff (2005) looks at how formal and informal institutions differ between the US, UK and Germany in relation to several areas where science and policy meet. Other comparative studies of science–policy interactions have also pointed to important cultural differences (Gillespie, Eva, and Johnston 1979; Brickman, Jasanoff, and Ilgen 1985). Pielke Jr (2007) argues that different approaches to democracy produce different roles for scientists within society. Constructivist approaches have emphasised that what constitutes scientific knowledge, and what value it is given, is highly contingent on individual and society. It suggests scientists' depictions of a 'misunderstanding' public is fundamentally an insecure reaction to the conditionality of their own knowledge (Wynne 1995). In another vein, the size, budget, and breadth of activities within a polity creates issues of advice capacity and prioritisation. In these situations, scarce science advice can be asked to play other roles too, such as one of international leadership (Gluckman, Goldson, and Beedle 2012). In a globalised world, persistent diversity of local contexts is often hidden and neglected (Hulme 2010), exacerbating the tension between 'universal' knowledge and local spaces of meaning-making (Callon 1999; Jasanoff 2010). An appreciation of both context and its changing dynamics also brings into focus the timing (Haas 2004) and venues (Baumgartner and Jones 2010; Pralle 2003) and their effectiveness. Through empirical analysis, it is hoped a more detailed understanding of when and how context frames and influences science advice processes will be gained.

UCL STEaPP offers a wealth of expertise on science policy structures, academic fields and institutions. This research will build on this knowledge base by developing a framework with a common structure and taxonomy of core variables which will evaluate the effectiveness of current science advice. Naturally, any attempt to distil such diversity of scholarship will inevitably not capture all of the richness intrinsic to the relevant viewpoints. It will be likely to miss out many of the nuances and endogeneity that may be present. However the scope of the variables we intend to capture is intended to be wide and integrative, rather than locating itself firmly in a certain theoretical camp. The frame-

work will be developed with the aim of addressing the two questions previously mentioned.

The framework we develop for undertaking this research will lead to surveys, meetings and interviews with science advisers, case studies both integrated and independently carried out from local, national, and international levels, and the studying of the roles of boundary organisations. The research will inform future research agendas as well as providing information on effective science policy relationships and methods of best practice.

We believe this is an important endeavour for a variety of reasons. Firstly, empirical work on science advice—particularly on concrete activities—is scarce, and very little of it is in directly comparable form. Certain spaces, levels and scales have been studied intensively to the neglect of others, which makes the generalisability of findings necessary for advice especially unclear. Secondly, a framework may guide researchers to also consider and control for potentially important factors that are outside of the immediate scope of their own disciplinary training and interest, as well as aid them in locating themselves amidst the community working on this issue. Thirdly, a well designed framework populated with data will be a useful tool for both qualitative and quantitative research, and may open up the possibility to answer many questions of interest that were previously more difficult to explore. Much of the scholarship on science advice has been undertaken deductively (Spruijt et al. 2014), and we believe an inductive approach would be fruitful at this point.

At this stage we welcome your feedback, and would be glad to hear from anyone who is undertaking a similar or compatible project, in order to dovetail our efforts in this area.

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