

How and what do science advisers learn?

Insights from environmental science-policy in the UK

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Painting by Tessa Wirz Obermeister

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Declaration

- This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the preface and specified in the text.
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זכרונו לברכה, Dedicated to Louis Obermeister,

Abstract

Through their engagements with science-policy, academics often have to revisit some of their enduring assumptions and expectations about the world of policymaking. They have to *learn* to become (effective) science advisers in diverse contexts. No instruction manuals or guidelines have quite prepared them for their experiences sitting on scientific advisory committees or meeting with civil servants. Many scholars have spoken about the importance of learning in the interactions between scientists and policymakers, but there has been little empirical investigation putting science advisers' learning under the microscope. How and what do they learn? How do the various advisory settings they inhabit shape their learning? And how (if at all) is their learning differentiated by levels of experience and other factors such as disciplinary training? These are some of the questions I address in this thesis. Based on in-depth interviews with experienced advisers and early-career researchers, and ethnographic observations of advisory meetings, I analyse the different moving parts in advisers' learning journeys and the extent to which their learning is *situated* and *transformative*. I argue that there are three levels at which such an analysis can be organised: the macro (professional cultures), micro (individual profiles), and meso (organisational cultures). I discuss them in that order. Following a grounded theory approach, I devise a model of advisers' learning based on the idea of the *cultural encounter* and two models of science advice (*collective intelligence* and *networked intelligence*) with repercussions on learning. I also introduce and reflect on methodological innovations, including an experimental pilot of longitudinal diaries and a stylised simulation of a scientific advisory committee. In the final chapter, I discuss the promise of these methods and present the practical implications of my findings for less experienced advisers, early-career researchers, educators, science-policy researchers, and knowledge brokers.

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Acronyms

AOB - Any other business

BEIS - Department for Business, Energy & Industrial Strategy

BSE - Bovine spongiform encephalopathy

CCC - Climate Change Committee

CSA - Chief Scientific Adviser

CSaP - Centre for Science and Policy

CUSPE - Cambridge University Science and Policy Exchange

CV - Curriculum vitae

Defra - Department for Environment, Food & Rural Affairs

EBP - Evidence-based policymaking

EIP - Evidence-informed policymaking

ESCAPE - Evaluation of Science Advice in a Pandemic Emergency

EU - European Union

GCSA - Government Chief Scientific Adviser

GMO - Genetically modified organism

GO Science - Government Office for Science

IfG - Institute for Government

IPBES - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC - Intergovernmental Panel on Climate Change

HSAC - Hazardous Substances Advisory Committee

LPP - Legitimate Peripheral Participation

MN - Methodological note

MP - Member of Parliament

NERC - Natural Environment Research Council

NGO - Non-governmental organisation

ON - Observational note

PF - CSaP Policy Fellow

POST - Parliamentary Office of Science and Technology

R&D - Research & development

REF - Research Excellence Framework

SAC - Science Advisory Council

SAGE - Scientific Advisory Group for Emergencies

SAPEA - Science Advice for Policy by European Academies

STS - Science & Technology Studies

STEM - Science, Technology, Engineering, and Mathematics

TN - Theoretical note

UK - United Kingdom of Great Britain and Northern Ireland

UKRI - United Kingdom Research and Innovation

UNFCCC COP - United Nations Framework Convention on Climate Change's Conference of the Parties

US - United States of America

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1 Introduction

How and what do science advisers learn? This is a question which has been the subtext of many conversations and scholarships on science-policy, but which - to my knowledge - has never been addressed in an in-depth empirical project. There is no doubt that the 'science of science advice' is an established (Jasanoff, 2013) and proliferating (Oliver & Cairney, 2019) field of research. Some studies have considered policymakers' learning from their interactions with scientists (e.g. Dunlop, 2009). And while there have been discussions of 'competencies' - with an acknowledgment that varying modes of science-policy interaction require different competencies (Maas et al., 2022; Schwendinger et al., 2022) - there is a general lack of 'empirical guidance' on how *policy literacy*¹ and science advisory skills are actually acquired (Oliver & Cairney, 2019). Moreover, despite efforts to include policy literacy in the scientific curriculum, many academics - including motivated early-career researchers - have a poor understanding of policy processes and are at a loss when it comes to getting involved (Andrews, 2017; M. C. Evans & Cvitanovic, 2018; Sasse & Haddon, 2019; Selin et al., 2017). A lot of the pedagogical work is instead carried out by senior science advisers who publish their insights gained from experience (e.g. Donnelly et al., 2018; Gluckman, 2014; e.g. Lawton, 2007; Sutherland & Burgman, 2015). Advice on science advice from practitioners is now commonplace in academic journals and circles.

I have argued elsewhere that more can be done with experienced advisers' accumulated wisdom, for instance with regards to *policy for science*² (see Obermeister, 2020). In light of the above, a qualitative, interdisciplinary empirical study of the learning experiences of science advisers should be of interest to scholars and practitioners alike. Such a study can contribute to our understanding of the broader relationship between science and policy, and the specific effects of types and sites of interactions on advisers' learning outcomes; information which is relevant for institutional and meeting design. It can also provide practical guidance for early-career researchers and less experienced advisers, as a repository of tips and 'warning signs' - i.e. common pitfalls and misunderstandings experienced by science advisers in the course of their learning journeys.

¹ Selin et al. (2017) define 'policy literacy' as: 'the knowledge and understanding of societal and decision-making contexts required for conducting and communicating scientific research in ways that contribute to societal well-being' (p. 2). I take it to mean specifically knowledge and appreciation of the explicit and tacit intricacies of policymaking.

² 'Policy for science' - as opposed to 'science for policy' - refers to the management and governance of scientific institutions and knowledge production (Pielke, 2007; Wilsdon, 2014).

My proposition is to examine how science advisers learn the art and craft of science advice, and what they learn. At one level, advisers must 'learn the basics' (e.g. the institutional makeup of the political system they are working within), but also - more challengingly - 'what, when, where and who to influence' (Oliver & Cairney, 2019, p. 3). Appropriate behaviours in science advice are rarely codified, and what constitutes best practice is a matter of debate (Montana & Wilsdon, 2021). Advisers' judgments are therefore loosely based on the '(perceived) demand for science and the (perceived) characteristics of supply' (Sarewitz & Pielke, 2007, p. 6). The vast majority of their learning is interactional, experiential, and incremental. Like any expertise, 'policy expertise is a skill acquired over time' (Bernard, 2022, p. 363). They learn from peers and the environments they move within, and sometimes from lived experiences that challenge or confound previously held assumptions or expectations.

For instance, 'scientists are often perplexed by the apparent failure of their evidence to affect policy... Although a tidy, analytically driven cycle of policymaking might seem logical to scientists trained in the tradition of hypothesis generation and testing, policymaking is instead a networked process in which scientific evidence is only one of many inputs' (Gluckman, 2016, p. 969). Moreover, and as I will go on to argue, the 'cultures of scientific research and policymaking are very different - mutual understanding between these worlds is not a given' (Warrell, 2022, p. 4). To become effective advisers, academics must learn to bridge the cultural divide and to navigate the 'cultures of the political institutions with which they interact' (ibid.). They must develop 'a sophisticated understanding of how policymaking processes work, and the pressures and constraints under which ministers, civil servants, and decision makers operate' (Wilsdon, 2014, p. 295). They must learn what their role entails, what kind of agency it affords them, and how to perform tasks for which they tend to be ill-prepared and ill-equipped.

The 'Grand Challenges' or 'wicked problems' that advisers are increasingly called upon to help resolve are ridden with irredeemable uncertainties and require the sorts of interdisciplinary collaborations which the dominant cultures in academia still struggle to incentivise (Freeth & Caniglia, 2019; Funtowicz & Ravetz, 1993; Grundmann, 2018; Honeybun-Arnolda & Obermeister, 2018; Maxwell & Benneworth, 2018). As it stands, 'the knowledge of most experts is so specialised that they are effectively laypeople with regard to issues beyond their immediate area of expertise' (M. B. Brown, 2008, p. 549). It is partly for these reasons that environmental science-policy has attracted so much scholarship. It is in this particular interface that linear, technocratic views of how science interacts with policy have most dramatically wavered; most notably the failure of the idea that more and better climate science will

galvanise political action and lead to better policymaking (Howe, 2014; Hulme, 2009; Jasanoff & Martello, 2004; Lahsen, 2009; Porter & Dessai, 2017; Sarewitz, 2010). As Owens (2015) suggests, environmental science-policy 'has been one of the most visible arenas in which experts have had to (re)negotiate their relations with other social actors' (p. 5). Resulting efforts to democratise science and encourage participatory forms of science-society dialogue (e.g. Chilvers & Kearnes, 2020; Irwin, 1995a; Jasanoff, 2003; Smallman, 2020; Whatmore, 2009; Wynne, 1993) will not feature prominently in this thesis, but I recognise that they are necessarily part of science advisers' experiences in and around environmental policymaking.

Despite the lack of empirical studies, it is also in literature on environmental science-policy that discussions of learning have been front and centre. 'Sustainability researchers and educators have viewed learning as an active and social process of transformation' (Budwig, 2015, p. 99). They have variously called for greater *social learning* (e.g. Wals, 2009), *adaptive learning* (e.g. Armitage et al., 2008), *organisational learning* (e.g. Pallett & Chilvers, 2015), and *transformative learning* (e.g. König, 2018). They have used 'transformative learning' as a shorthand for collective learning for transformative systems change, paying little attention to the transformative learning of 'scientists' advocating for those changes. By focusing on the environmental science-policy interface, I seek to address transformative learning at the level of the individual³, in an arena where advisers' tasks are anything but straightforward. I recognise that this limits the generalisability of my findings, as there are necessarily differences between environmental science-policy and other science-policy domains⁴ (Montana & Wilsdon, 2021). I nevertheless believe that some 'lessons... can be transferred sensitively from one context to another' (Gluckman & Wilsdon, 2016, p. 3), across different science-policy issues within the UK.

My choice of the UK as the sole jurisdiction for this study was driven by several factors. The UK combines a long and rich history of institutionalising (environmental) science advice, with strong principles of separation between government and science⁵ (Agar, 2019) and linear depictions of science-policy (Palmer et al., 2018). Equally, 'the UK is widely viewed as a significant contributor to the theory and practice of evidence and policy interactions' (Montana & Wilsdon, 2021, p. 4), and the literature on UK science advice offers some points of

³ As originally theorised by Jack Mezirow. See Chapter 3 for more information.

⁴ I do not unpack those differences in the thesis (see Chapter 8 for an explanation).

⁵ One salient example is the Haldane principle - named after Richard Burdon Haldane - which is the idea that funding decisions should remain mostly in the hands of research organisations. Although it was invented many years after the Haldane report of 1918, it continues to be invoked to describe the ideal relationship between government and academia and/or criticise excessive government intervention in research (Agar, 2019; Edgerton, 2009; Sasse & Haddon, 2018).

comparison for external validation of my empirical research. And practically speaking, for an ambitious empirical project involving many elite actors, access was a key consideration in my initial research design; by focusing on the UK, I was able to tap into numerous networks (within Cambridge and beyond), as well as my personal cultural capital.

Before proceeding to a short description of the design and contents of this thesis, I would first like to offer a few important definitions and clarifications. Science is to be understood as *Wissenschaft* - i.e. 'systematic enquiry that aims to produce reliable knowledge' (M. B. Brown, 2017, p. 5) - and therefore includes the social science and humanities⁶. 'Science advice', 'policy advice', and 'expert advice' are used interchangeably, as are 'scientist', 'researcher', and 'academic'. This thesis takes 'science adviser' to mean academics who ordinarily work in universities or non-governmental research institutes and who act as advisers to policymakers in formal and informal capacities on a time-limited basis. Government scientists were excluded because many of them are more deeply embedded in the culture and politics of policymaking - and their ability to speak freely is consequentially more limited - than university researchers. Their interactions with policymakers are familiar and routine.

Conversely, 'the sporadic nature of academics' appointments as advisers (generally short-term or part-time) suggests the learning experiences of academics are more likely to be associated with discrete events or anecdotes; hence potentially more conducive to being studied' (Obermeister, 2020, p. 2). Finally, 'by "policymakers" I broadly mean (influential) actors within government departments, the legislative branch (e.g. Parliament), and/or organisations with statutory powers (e.g. non-departmental public bodies), who are chiefly concerned with policy formulation and evaluation as opposed to enforcement' (Obermeister, 2020, p. 2). Policymakers can therefore include politicians, although I tend to treat politicians separately, for reasons that will become clear in Chapter 5.

The departure point for this research project is the hypothesis that advisers' learning is always going to be *situated* within particular science-policy arrangements and organisational environments, and will sometimes be *transformative* due to significant and sometimes intractable differences between both worlds. A wealth of literature in the social studies of science has considered advisory and 'arm's length bodies'⁷ in both breadth and depth (see

⁶ I do however occasionally separate these out for analytical purposes.

⁷ 'A general term used to cover at least 11 types of organisation which operate at varying, and often contested, degrees of independence from government. They range from big organisations employing thousands of public servants and administering billions of pounds of public money, to small advisory committees with no independent budget. They regulate some of the most sensitive areas of public and private activity' (IfG, 2022, para. 2)

Bijker et al., 2009; J. Boswell, 2018; Jasanoff, 1994, 2005a; Owens, 2015; Turnpenny et al., 2013), but not the learning experiences of individual science advisers within these organisational environments. This thesis seeks to address this gap by combining qualitative interviews with ethnographic observations of three sites of science advice.

In order to capture data from across the spectrum of experience, I interviewed both experienced advisers and former interns of a policy placement scheme designed for PhD students⁸. I also conducted two methodological experiments (or pilots) - consisting of diaries and a simulation exercise - and reflect on their promise for research and pedagogy in Chapter 8. Combinations of diaries, observations, and interviews have already been used in 'on-the-job learning' research (Berings et al., 2006), and anthropological approaches to studying 'the local culture and practices of scientific advising' practices of science advice are not new (Bijker et al., 2009, p. 34). I bring these two research paradigms together. I expand on my theoretical framework and research methods in Chapter 3, and my data collection and sites of study in Chapter 4. The analysis derived from the interview and ethnographic data is presented in Chapters 5 to 7. The ensuing chapter (Chapter 2) is a literature review on the role(s) of science advisers and the 'institutions of advice-giving' (Jasanoff, 2005b). My research questions are given below, and my answers to them in Chapter 8.

1. What and how do academics learn from their roles as advisers?

- How do advisers learn? Are advisers born or made?
- What are some of the lessons learnt by advisers?
- Are the moments of (transformative) learning clearly identifiable?
- What do they learn about the role of science adviser and what it means to be skilful?
- What are some of the important factors that influence and differentiate their learning?

2. How do the 'spaces of encounter'⁹ shape advisers' learning?

- How does the mode or model of interaction affect their learning?
- What role do institutions and organisational cultures play?

3. What can we learn from studying advisers' learning?

⁸ Although my definition of 'science adviser' does not quite capture the role of policy interns, they nonetheless represented the clearest cohort for a longitudinal analysis of learning (i.e. my original plan before COVID-19 derailments). Furthermore, very few academics at the PhD or first post-doc stage are actively and identifiably involved in science advice, with the exception of those conducting research in partnership with policymakers and submissions of evidence to parliamentary select committees, for example. Finally, and despite its clear value, few studies have considered the impact of secondments in UK policy institutions (Sasse & Haddon, 2018) beyond a report evaluating the impacts of policy fellowships in the UK parliament and devolved legislatures (see Parry, 2021).

⁹ Defined in more detail in Chapter 5, I call 'spaces of encounter' the spaces where the worlds of science and policy intersect and/or meet. They can be material or immaterial spaces. And it is within such spaces that exchanges, collaboration or conflict, and learning occur.

2 Literature review

This chapter presents a curated selection of the existing academic literature that inspired and informed the research questions and resulting empirical analysis of this thesis. It is organised into two sections: i) the roles of experts in democracies and, in particular, of science advisers in evidence-informed policymaking, and ii) the (eco-)systems of science advice within which they operate, with an eye to the specificities of the UK.

2.1 Expert advice in democracies

Scientists can fulfil many functions on the public stage. They can be communicators (D. V. Smith et al., 2016), educators (Alberts, 1994), public intellectuals (Bijker, 2003; Collini, 2006), influencers (e.g. Prof Brian Cox), activists (Bassett, 2020), policymakers (Kattirtzi, 2016) or politicians (e.g. Margaret Thatcher or Angela Merkel). Across the spectrum, they have varied extrinsic and intrinsic motivations to participate in public debates (Sharman & Howarth, 2017) and to try to influence policymaking (Oliver & Cairney, 2019). Since the end of World War II, scientists have generally preferred to act as advisers and scientific advisory bodies have established themselves as indispensable tenets of modern democracies (Donovan et al., 2012; Ezrahi, 1980; Jasanoff, 2005b, 2005a; Shindell, 2019; Weingart, 1999).

Nearly a decade ago, Spruijt et al. (2014) published a literature review about the 'roles of scientists as policy advisers on complex issues', concluding that the roles of science advisers are manifold and depend on the 'type of issue (simple or complex), the type of knowledge an expert has, the core values of an expert, the organisation in which an expert works, the changing beliefs of experts, and the context' (p. 22). In other words, the answer to the question 'what do science advisers do?' is 'it depends'. Figuring out what exactly it is that science advisers do - and are supposed to do - is further complicated by the fact that the 'issues for which scientific input is most needed by policymakers are the ones for which the science is most often complex, multidisciplinary and incomplete' (SAPEA, 2019, p. 12). Moreover, there are persistent disagreements on the role of science in policymaking - and especially so in crisis situations¹⁰ (Donovan, 2021) and the climate change arena (Hulme, 2009).

Notwithstanding such ambiguities and complexities, science advice to governments is here to stay. Firstly, incentives structures in academia continue to shift towards encouraging more

¹⁰ The subtle but important differences between science advice on emergencies and business-as-usual science advice (see Donovan, 2021 for example) are not addressed in this thesis, except when they are brought up by research participants.

policy impact (C. Boswell & Smith, 2017; Regan & Henchion, 2019). For instance, the latest UK Research Excellent Framework (REF 2021) - which determines the distribution of a significant portion of public funding to universities - included 'major changes in policy or practice' (REF, 2019, p. 36) as a criterion for achieving a full score (i.e. four stars). Secondly, the cultural authority of science - and the associated reliance of politicians on the factual statements it generates - were on full display in the early stages of the COVID-19 pandemic, despite widespread worries of a crisis of expertise in the UK and other western democracies (Bucchi, 2017; Moore, 2017; Saltelli & Funtowicz, 2017). As Grundmann (2018) suggests, it would appear that 'the so-called populist backlash against science and expertise as a general claim is a figment of the imagination, itself in the land of opinion and post-truth' (p. 373). While it is clear that experts of all sorts have become legitimate and influential actors in democratic governance¹¹, there is still volatility and contestation surrounding the roles they play, the challenges they face, and their 'rightful place' in public life and policy (Grundmann, 2018).

2.1.1 Experts in public life

Grundmann (2018) offers a helpful typology¹² to understand what sets an 'expert' apart from other knowledgeable practitioners. He distinguishes the role of *expert* from that of *specialist*, *professional*, or *scientist*; all of whom he argues seldom have to engage in 'public debates' and address 'value conflicts' (Grundmann, 2018). His core argument is that scientists must recognise that when they act as experts in public life (including as science advisers), they are doing something quite apart from their day-to-day professional activities. Experts are often 'asked to deal with situations for which their training and their experience has not prepared them', and 'under conditions of uncertainty where at the same time values are conflicting' (Grundmann, 2018, p. 381). Experts in public life regularly have 'to transgress the limits of their competence' (Nowotny, 2003, p. 152). They must abandon the 'value-free ideal' (Douglas, 2008), learn to work on issues outside of their immediate subject matter expertise (Sutherland & Burgman, 2015), translate scientific work into accessible messages (Andrews, 2017), and much more.

¹¹ Discussions on the different 'technocratic', 'decisionist', or indeed 'epistocratic' logics and models of governance are outside of the scope of this thesis.

¹² This thesis does not seek to address the question of what constitutes 'expertise', nor does it comprehensively consider the many typologies that have accompanied those debates (e.g. Collins & Evans, 2007).

Especially when dealing with 'wicked problems', or *post-normal science*¹³ (Funtowicz & Ravetz, 1993, 1994), experts in public life must accept the heightened place of value conflicts in their work (Gluckman, 2014; Wilsdon, 2014). This can be frustrating for scientists, whose own values might clash with those of their audiences. Indeed, not all actors in public life live up to Mertonian norms¹⁴. Moreover, when there are high levels of uncertainty and/or urgency, public-facing experts can be more vulnerable to political manoeuvring and manipulation (Donovan, 2021; Donovan et al., 2012). They can face death threats and other bullying (see SAPEA, n.d.-a). They can even be the target of legal action regarding the consequences of their advice, as was the case for the L'Aquila earthquake of 2012, for example (see Donovan, 2021).

It is common and can be rational for publics to defer to expertise (Hardwig, 1985) and remain largely passive in their judgments of scientific claims (Moore, 2017). As many scholars have pointed out, 'expert pronouncements carry with them a certain weight, the weight of *epistemic authority*' (Douglas, 2008, p. 3). But deference to epistemic authority only lasts until science and related decisions come up against conflicting mental models and values (Sharman & Howarth, 2017). In such instances, science can become contested and highly politicised (M. B. Brown, 2015, 2017). And scientists can be at a loss, because more science and data seldom resolves these conflicts and controversies - instead making them worse (Hulme, 2009; Sarewitz, 2004). The technical fix mentality (or ideology), which positions science as able to remedy political ailments in society is called *scientism* in the literature (Blue, 2018).

In reality, scientists' agency is generally limited: 'the potential for science to contribute to societal goals depends critically on factors well beyond science' (Sarewitz & Pielke, 2007, p. 6). Moreover, scholars in the social studies of science have demonstrated that science and its reception are culturally (see Jasanoff, 2005a) and geographically (see Mahony & Hulme, 2016) mediated. In sum, scientists as experts in public life often find themselves in the realm of *trans-science*, where questions 'can be stated in the language of science', yet 'are unanswerable by science' (Owens, 2015; Weinberg, 1972, p. 209). So, why do many scientists

¹³ Refers to science on systems that combine irremediable, *epistemological uncertainty* and high political decision stakes (Funtowicz & Ravetz, 1993). In other words, science where 'facts are uncertain, values are in dispute, stakes are high, and decisions urgent' (Funtowicz & Ravetz, 1994, p. 1882). 'Post-normal science has the paradoxical feature that in its problem-solving activity the traditional domination of "hard facts" over "soft values" has been inverted' (Funtowicz & Ravetz, 1993, p. 750).

¹⁴ One of the very first sociologists of science, Robert Merton, argued that scientists were governed by four ideal norms, namely: *universalism*, *communism*, *organised scepticism*, and *disinterestedness* (see Merton, 1973). They have come to be known as 'Mertonian norms'.

bother getting involved? Chiefly because they share a normative commitment to public policy that is informed (or indeed based on) scientific evidence¹⁵.

2.1.2 Evidence-informed policymaking

'I sometimes wonder if we are creating an evidence-based policy industry', writes Leighton Andrews (Andrews, 2017, p. 16), a former Welsh Minister. Those words come in view of a proliferation of the idea of evidence-based policymaking (EBP), and its latest evolution: evidence-informed policymaking (EIP). 'Based' was dropped because, as Weinberg (1972) noted 50 years ago, 'the scientist and science provide the means; the politician and politics decide the ends', and because the utopia of 'rational' decision making never came to fruition (Cairney, 2019; Ezrahi, 1980). Scientific knowledge is only one of the knowledge inputs in political decision making, and is recognised as such by experienced science advisers (e.g. Gluckman, 2014). The unspoken belief underpinning EBP or EIP, is that through the inclusion of scientific evidence, better decisions can be reached.

The extent to which this is supported by evidence is in fact limited, not least because of differing opinions over what counts as 'better' and so on. Especially if and when the expectation is that the products of science advice will provide policymakers with win-win policy options that please all interested parties, it is clear that EIP will never deliver (Ezrahi, 1980; Sarewitz & Pielke, 2007). Nevertheless, institutions such as arm's length scientific advisory committees continue to be set up to help improve 'the epistemic quality of the decisions reached by government officials, interest groups, and individual citizens' (M. B. Brown, 2008, p. 548). These groups are tasked with synthesising or producing *policy relevant* knowledge. While 'policy relevance' gets thrown around a lot by practitioners and commentators, it is rarely defined (Oliver & Cairney, 2019); it can have many meanings and be achieved by many means (Dunn & Laing, 2017).

Interactions between scientists and policymakers have been conceptualised in a variety of ways (C. Boswell & Smith, 2017), but the prevalent mental model amongst actors in EIP and for institutional design has been the *linear model* of science-policy. This not quite the same as the linear model of innovation, where basic science is seen to eventually translate into useful applications (Agar, 2019; Sarewitz, 2017). Instead, it is the idea that scientists can just provide the knowledge without getting mired in the politics. The one-way unidirectional flow of information - 'from problem identification to problem solution' (Gluckman et al., 2021, p. 85) - supposedly then protects the independence and sovereignty of both spheres. Some

¹⁵ Of course, science advisers have diverse motivations for engaging. I address this topic in Chapter 6.

believers and advocates of the linear model also see consensus amongst scientists as a driver of political action (Pearce et al., 2017; Turnhout & Lahsen, 2022).

Yet despite its stronghold on scientists' imaginary, the *linear model* of science-policy interactions has very little grounding in reality (C. Boswell & Smith, 2017; M. B. Brown, 2008; Cairney, 2019; Donovan, 2021; Gluckman et al., 2021; Hilgartner, 2000; Hulme, 2009; Karhunmaa, 2020; Maas et al., 2022; Owens, 2015; Palmer et al., 2018; Pielke, 2007; SAPEA, 2019; Turnhout & Lahsen, 2022; Weingart, 1999). Experts in public life are not there to address a 'deficit' in public understanding and a deficit approach to science communication has only tended to exacerbate political conflicts rather than resolving them (Blue, 2018; Gregory & Lock, 2008; Irwin, 1995b; Lawton, 2007; Saltelli & Funtowicz, 2017; Sarewitz, 2004; Scheufele, 2014; Wynne, 1993). In some cases it has made experts the targets and victims of political scheming. With regards to climate change, Howe (2014) argues that 'the science-first approach to climate change advocacy' led to a 'tragedy', because 'scientists' and environmentalists' reliance on science as a driver of political action also gave their opponents a clear target: science itself' (p. 9).

It is not just scientists who hang onto this idealised model of interaction; policymakers can uphold the linear model too (Oliver & Cairney, 2019). It is a convenient fiction within which independence and clear divisions of labour are preserved. Through routine *boundary work*¹⁶, advocates of the linear model implicitly claim that they can draw a line between where the science ends and the politics begin; science's independence and politics' sovereignty are discursively maintained (Maas et al., 2022; Owens, 2015). In the literature, the linear model has often been opposed to the *coproduction model* of science advice (Maas et al., 2022). There are at least two ways in which coproduction is understood here. One is a constructivist school of thought that sees science and social order as coproduced, as intimately intertwined (e.g. Chilvers & Kearnes, 2020; Jasanoff, 2004; Mahony & Hulme, 2016; Pallett & Chilvers, 2015). The other is a far more process-oriented use of the term, namely as the conscious or unconscious collaboration in producing knowledge in science-policy (e.g. Bijker et al., 2009; Cash et al., 2003; Maas et al., 2022; Oliver & Cairney, 2019; Owens, 2015; Palmer et al., 2018; Porter & Dessai, 2017; Reed et al., 2014). In that sense it is synonymous with *co-design*, which is used liberally in environmental science-policy scholarship (e.g. Reed et al., 2014).

¹⁶ Originally refers to the ideological demarcation of science from non-science (see Gieryn, 1983), but has been employed in other ways since. I present these various conceptualisations in Chapter 8.

What both of them draw attention to is the extent to which the relationship between scientists and their policy or political counterparts is mutually constituted, highlighting shared responsibilities in the challenges and barriers they face in their collaboration and communication. For example, scientists can be guilty of not engaging (Oliver & Cairney, 2019), displaying a lack of 'thought leadership' (Boyd, 2019), assuming rather than defending the privileged status of scientific knowledge (Gluckman, 2014), failing to include 'policymaker perspectives' in their research (Neal et al., 2021), or being too 'vague' or 'narrow' in their recommendations (Dunn & Laing, 2017). Meanwhile, policymakers can be guilty of remaining as 'passive recipients of knowledge' (Maas et al., 2022, p. 5), not searching for or requesting access to research outputs (Craig, 2019), formulating questions that scientists can hardly answer (CSaP, 2013), expecting and demanding certainty (Spruijt et al., 2014), and failing to sustain government's institutional memory (Dunn & Laing, 2017; Sasse & Haddon, 2018; Warrell, 2022).

Politicians and policymakers can also be guilty of *policy-based evidence* - i.e. cherry-picking or distorting evidence so as to legitimate their existing position (Andrews, 2017; Cairney, 2019; Smallman, 2020) - although such accusations are not always justified and often display poor understandings of policymaking (Cairney, 2019). Politicians and policymakers may also attempt to *depoliticise* a controversial issue by putting them to scientific advisory committees (Group of Chief Scientific Advisors, 2019; Turnhout et al., 2020). Finally, there are numerous structural and cultural differences, where neither party is at fault - for instance the vastly different timelines on which scientists and policymakers operate (Dunn & Laing, 2017). I talk about many more of these differences in the remainder of the thesis.

2.1.3 Scientists as policy advisers

Despite attempts to codify and discipline science advice (e.g. the UK's Code of Practice for Scientific Advisory Committees and Councils: CoPSAC 2021), the positionality and normative preferences of advisers with regards to their roles vary (as illustrated by Pielke, 2007). In fact, science advisers - and the institutions they inhabit - 'perform multiple roles, sometimes simultaneously', and it can be 'both possible and productive' for them to do so (Owens, 2015, p. 17). In the case of *regulatory science*, advisers may be called upon to produce knowledge, synthesise it, or provide predictions (Jasanoff, 1994). They can be involved in practices of *supplying* (provide knowledge outputs), *bridging* (match knowledge outputs with policy questions) or *facilitating* (actively lead a process of coproduction) (Maas et al., 2022; Turnhout et al., 2013).

In the UK, science advisers are also expected to act as convenors; as bridges between Whitehall and networks of external experts (Warrell, 2022). In all these activities, they are frequently expected to act as 'impartial' voices, despite being 'acutely aware of how their work mixes ethical, political and scientific judgements' (Turnpenny et al., 2013, p. 588). They generally work backstage (Bijker et al., 2009; Hilgartner, 2000) - largely undisturbed by political turbulence - but can sometimes be propelled to the frontstage, as was the case during the early days of the COVID-19 pandemic in the UK (Walker, 2020). And science advisers are normally not involved in public science funding decisions, because of possible conflicts of interest (Gluckman, 2014).

To build trust, science advisers might need to: act as 'neutral' or 'honest' brokers of knowledge rather than advocates (Gluckman, 2014; Gluckman et al., 2021), communicate the limitations of evidence and their advice (Donnelly et al., 2018; Gluckman, 2014), and display inordinate amounts of patience, persistence, and humility, because trust-building takes time (Andrews, 2017; Oliver & Cairney, 2019; Warrell, 2022). They must also preserve the trust and reputation they have with colleagues in science, who expect high (and often unrealistic) standards of professional conduct and rigour (Jasanoff, 2013). All while trying to seize the short-lived windows of opportunities in the policy cycle and respond to the quick turnaround requests from policy colleagues (Dunn & Laing, 2017; M. C. Evans & Cvitanovic, 2018; Oliver & Cairney, 2019). Moreover, as brokers, science advisers must somehow 'understand the information needs of the policymaker, even when it may not be clear to policymakers themselves'; a feat which requires skill and training (Gluckman et al., 2021, p. 87).

Indeed, communication skills, in particular, are highly valued in science advice circles (see Oliver & Cairney, 2019; Scheufele, 2014). Science advisers also have to conjure 'imaginaries of the public' and frame their advice accordingly (Ballo et al., 2022). Finally, when the government is acutely aware of the need for science advice (e.g. Fukushima), science advisers only need to worry about how to gather, synthesise, and present evidence in 'the most effective way' (Beddington, 2013, p. 22). Their task, conversely, is much harder when it comes to endemic, long-term, wicked problems where events and decisions are neither discrete nor self-contained (Beddington, 2013), and where science advice that is multi- or trans-disciplinary is generally preferable (SAPEA, 2019).

In the UK, and abroad¹⁷, the most visible science advisers have been Chief Scientific Advisers (CSAs) - specifically the Government Chief Scientific Adviser (GCSA) and departmental CSAs.

¹⁷ The CSA model has spread globally and has been implemented in countries such as Australia, India, and New Zealand (Doubleday & Wilsdon, 2012; Wilsdon, 2014).

The GCSA advises the Prime Minister and Cabinet¹⁸ on science-related issues, and coordinates the work of departmental CSAs, who advise their respective departments' Ministers and Permanent Secretaries¹⁹. Most CSAs work on a part-time, time-limited basis, and continue to work in their previous role, generally within a university (A. C. Cooper, 2016). They are effectively temporary civil servants who can be called upon to provide strategic, long-term advice or short-term, reactive advice (Beddington, 2013). They act as bridges between their science and policy colleagues, and rely on networks and institutions to rapidly and effectively mobilise expertise beyond their own.

Variations in the remit and influence of departmental CSAs in different government departments continue to this day, ten years after the House of Lords' Science and Technology Committee flagged such discrepancies as an issue (see Select Committee on Science and Technology, 2012). The very same report stated that the most important personal characteristic of a CSA is their 'standing and authority within the scientific community, nationally and internationally' (Select Committee on Science and Technology, 2012, p. 5). They embody a particular British culture of science-policy (Palmer et al., 2018), which I expand on in Section 2.2.2 below.

2.2 The ecosystems of science advice

For Gluckman and Wilsdon (2016), science advice has its own ecosystem within which various organisms interact formally and informally. They are composed of networks of individuals and institutions that coalesce, cooperate, or collide. In most cases, these ecosystems are more diverse now than they have ever been²⁰ (Gluckman & Wilsdon, 2016). They vary across national contexts and 'the factors that affect whether or not advice is regarded as trustworthy by different groups of people is a cultural issue' (Donovan, 2021, p. 2). Comparing the cases of the UK, US, and Germany, Jasanoff (2005a) found diverging approaches to science advice, which she called *communitarian*, *contentious*, and *consensus-seeking*, respectively. For instance, in Germany, advisers' institutional affiliations are crucial for the composition and legitimacy of committees. In the UK, the emphasis is on advisers' academic and public credentials and reputations - as illustrated by the aforementioned House of Lords report on CSAs.

¹⁸ The Cabinet is composed of the Prime Minister, heads of departments (i.e. Secretaries of State), and other senior ministers and political appointees.

¹⁹ The highest rank of civil servant in a government department.

²⁰ Like with any ecosystem, diversity is generally seen as a strength in science advice circles.

She called these different 'institutionalised practices by which members of a given society test and deploy knowledge claims used as a basis for making collective choices', *civic epistemologies* (Jasanoff, 2005a, p. 272). Furthermore, 'the geography of scientific advice and civic epistemologies is highly variable: institutional structures, responsibilities, remits and cultural assumptions about knowledge differ not only between countries but often at more local levels too' (Donovan, 2021, p. 6). We can therefore expect the UK to have its own idiosyncrasies, its own civic epistemology (Montana & Wilsdon, 2021), a point which I return to in Chapter 5.

2.2.1 The institutions of advice-giving

With regards to the institutions that inhabit these diverse ecosystems, there are of course organisations wholly in either the research sphere (e.g. universities) or the policy sphere (e.g. government departments), but there are also *boundary organisations* (Guston, 2001). 'Boundary organisation' is often used as a shorthand for different sorts of science-policy organisations (Maas et al., 2022), which act as *knowledge brokers*, *intermediaries*, and/or *boundary spanners* (Neal et al., 2021). These different concepts - which come from different fields of academic literature - broadly describe a similar set of activities²¹: building capacity, fostering relationships, organising evidence synthesis, translating and disseminate technical documents, and/or facilitating knowledge exchange between the producers and users of (scientific) knowledge products (Gluckman et al., 2021; Neal et al., 2021; Turnhout et al., 2013).

I see boundary organisations as including institutions nested within government (e.g. scientific advisory committees) or within universities (e.g. Universities Policy Engagement Network). Boswell (2018), for example, argues that arm's length bodies such as the Food Standards Agency (FSA) should be conceived as boundary organisations. Sometimes boundary organisations are self-organised and governed by scientists, such as national academies or learned societies - which play an important role in science for policy and policy for science in western democracies (Group of Chief Scientific Advisors, 2019; SAPEA, 2019; Wilsdon, 2014). What characterises all these boundary organisations is that they are targeted at - and sometimes accountable to - both sides of the 'boundary' (Guston, 2001).

Within ecosystems of science advice, the institutions that have monopolised most of the public, political, and scholarly attention have been advisory councils and committees. Whether

²¹ I use 'knowledge broker' for this role in the remainder of the thesis. Individuals can also be knowledge brokers, as illustrated by Section 2.1.3 on the roles of science advisers.

they are standing or ad hoc, inside or outside government and other governance institutions (e.g. parliament), they provide 'a flexible, low-cost means for government officials to consult with knowledgeable and up-to-date practitioners in relevant scientific and technical fields, supplementing the unspecialised and sometimes pedestrian expertise available within the executive branch' (Jasanoff, 1994, p. 1). There are subtle but important differences in how these committees operate across fields and geographies. But there are equally some commonalities, insofar as they seek to balance trust with transparency²² and influence, all while working to preserve their independence and maintain high standards of quality assurance (Wilsdon, 2014). They can either be highly specialised or multidisciplinary and broad.

Even in the most specialised advisory committees, however, committee members 'rarely restrict their deliberations to purely technical issues. In fact, the experts themselves seem at times painfully aware that what they are doing is not "science" in any ordinary sense, but a hybrid activity that combines elements of scientific evidence and reasoning with large doses of social and political judgment' (Jasanoff, 1994, p. 229). Finally, much like advisers themselves, their activities can be hidden from view or visible and transparent (Bijker et al., 2009; Hilgartner, 2000). I discuss advisory committees and their functions in greater depth in Chapter 7.

2.2.2 A short history of UK science advice

The UK has a long history of calling upon academic knowledge for public policy and formalising the relationship between academic expertise and policymaking. The first Government Chief Scientific Adviser was Lord Solly Zuckerman. He was appointed in that role in 1964, but had been advising the British government since World War II (Agar, 2019; Wilsdon, 2014), and government chief scientists had existed since at least 1920 (Craig, 2019). Zuckerman was instrumental in bringing environmental issues to the fore in British politics and science policy (Owens, 2015). The first Cabinet-level environment ministry in the UK, the Department of the Environment, was established a few years later in 1970, as was a standing scientific advisory committee with powers to summon witnesses: the Royal Commission on Environmental Pollution (RCEP) (see Owens, 2015 for an analysis of the rise and fall of the Commission).

A few years previously, in 1966, the Select Committee on Science and Technology had been established in the House of Commons (Science and Technology Committee, 2010, sec. '1966-

²² Which is important for their credibility and trustworthiness amongst academic peers and the public at large.

1979'). The select committee system (in both the House of Commons and Lords) has since then become one of the main mechanisms through which the UK government is held to account on its use and interpretations of science, and one of the most important channels for academics to present or submit evidence for (bipartisan) consideration in policymaking (Andrews, 2017; Tyler & Akerlof, 2019). With regards to environmental issues in particular, the Environmental Audit Committee (EAC) was created in 1997 and plays an important role in evidence-informed policymaking (Turnpenny et al., 2013).

In 1971, as Secretary of State for Education and Science, Margaret Thatcher oversaw the 1971 Rothschild reforms, which led to most government departments appointing a CSA (Agar, 2019; Parker, 2016). Despite being trained as a scientist, Margaret Thatcher was the UK's first 'anti-technocratic' Prime Minister (Agar, 2019). Her relationship with environmental science-policy was for the most part ambivalent. While she lamented calls from science advisers for greater top-down regulation (e.g. on pesticides), she is also known for her explicit recognition of climate change and other global environmental challenges (ibid.). Her speeches at the Royal Society in 1988 and at the United Nations General Assembly in 1989 were notable for those reasons (ibid.). For example, at the Royal Society she said: 'protecting this balance of nature is therefore one of the great challenges of the late 20th century and one in which I am sure your advice will be repeatedly sought' (Thatcher, 1988, sec. 'The Environment').

During the 1980s and 1990s, science advice underwent a 'series of crises', which destabilised its ongoing institutionalisation and relatively privileged relationship in political decision making (Ballo et al., 2022). Most notably BSE²³ (or 'mad cow disease') wherein public trust of politicians and their scientific advisers with regards to the safety of British beef was damaged. Science advisers had been 'pressured into reassuring a public that was seen as incapable of responding sensibly to uncertainty' (Ballo et al., 2022, p. 3). Compounded by later controversies surrounding the push for genetically-modified crops (GMOs), the mid- to late-1990s were characterised by an imperative to (re)gain public trust and confidence in the management of emerging technologies - and associated risks in the UK - and to (re)legitimise science by making it more sensitive to societal preferences (Grove-White, 2001, 2006). This implied a move away from paternalistic, top-down communication to an emphasis on dialogue, which culminated in the report *Science and Society* published by the House of Lords' Science and Technology Committee (Agar, 2019; Ballo et al., 2022; Gregory & Lock, 2008; Grove-White, 2001; Smallman, 2020).

²³ Bovine spongiform encephalopathy is an incurable and inevitably fatal neurodegenerative disease amongst cattle.

The idea of evidence-based policymaking was consolidated by successive Tony Blair governments (Andrews, 2017). The first New Labour government (1997 to 2001) worked to rebuild trust after the BSE and GMO controversies, and as such established the Food Standards Agency (FSA) - an important site of evidence-informed policymaking (J. Boswell, 2018; Grove-White, 2001). The same government also oversaw the publication of a white paper which advocated for improving the 'use of evidence and research in policymaking and better focus on policies that will deliver long-term goals' (see Prime Minister & Minister for the Cabinet Office, 1999, p. 16). The Blair years were characterised by an unprecedented number of quangos²⁴ and high levels of interdisciplinarity in science advice. A reverse trend happened under the Cameron-Clegg coalition, with the so-called 'bonfire of the quangos' - which amounted to 'abolishing 192 government agencies, merging another 118 and substantially reforming a further 171', according to *The Guardian* reporting in 2010 (Curtis, 2010). One of the victims was the aforementioned Royal Commission on Environmental Pollution (Owens, 2015). The bonfire was not motivated by an outright rejection of evidence-informed policymaking, but was rather part of generalised cuts in public spending.

The most recent, and possibly most important, phase in UK science advice has been the COVID-19 pandemic, especially in its early days, during which 'advisers and scientific experts who normally operated backstage were thrust into the spotlight' (Ballo et al., 2022, p. 2). The UK government's political slogan 'we're following the science' was hotly contested and a subject of debate in both the academic and mainstream press (Bacevic, 2020; Devlin & Boseley, 2020; Ramakrishnan, 2020; Stevens, 2020). The aftermath of this extraordinary and unusual period for science advice is still under evaluation (see CompCoRe Network, 2022; Donovan, 2021; EScape, 2020; Pearce, 2020). All in all, this very short historical overview of science advice in the UK omits many important innovations and initiatives, such as the Scientific Advisory Group for Emergencies (SAGE), Sciencewise (Smallman, 2020), the What Works Network (see Evaluation Task Force, 2022), but hopefully provides sufficient context for my empirical analysis. For clarity, I will occasionally remind the reader of these developments and explain the functions of the various moving parts of the UK's science advice ecosystem throughout the remainder of the thesis.

²⁴ Stands for 'quasi-nongovernmental organisation' and encompasses many of the arm's length bodies, including non-departmental public bodies (e.g. Natural England and many of the scientific advisory committees), non-ministerial government departments (e.g. FSA), and executive agencies (e.g. Met Office).

3 Theory and methods

In this chapter I introduce, in more detail, the conceptual foundations and methodology of this thesis. Throughout the chapter, the theories around (adult) learning are interwoven with justifications for the research methods used. There are at least three compelling reasons for doing so: i) in designing the research project, a multi-methods approach sought to directly address the different dimensions of both learning (in theory) and science advice (in practice); ii) the relative lack of a mature sociological - or qualitative social scientific - methodology for studying adult learning suggests that the initiation of a conversation between theory and methods would be welcome; and iii) this is in line with an agnostic mindset towards the data (see Section 3.2.2) and a grounded theory approach (see Section 3.4).

The first section provides a short overview of adult learning on the job. The second section combines a discussion of Mezirow's (2000) theory of *transformative learning* with Rogers' (1945) *nondirective interview*. The third section presents the relationship between *situated learning* (Lave & Wenger, 1991) and my ethnographic approach. The fourth and last section lays out the analytical framework of this thesis, closely aligned with *informed grounded theory* (see Thornberg, 2012).

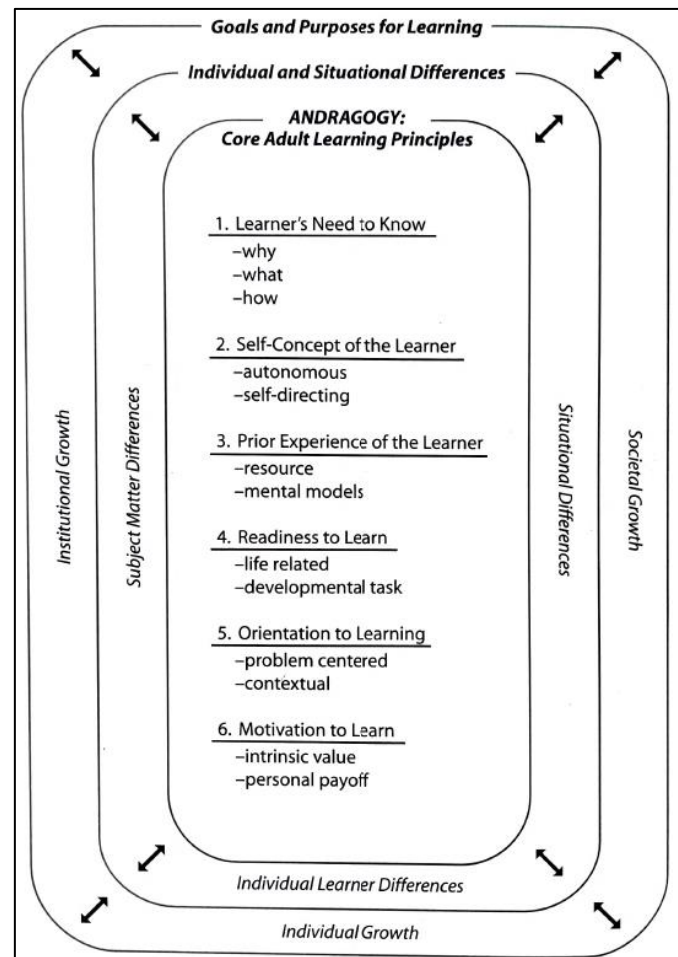
3.1 Andragogy and the significance of learning by doing

Malcom Knowles used the idea of *andragogy* - as opposed to *pedagogy* - to distinguish adult learning from child learning. It seems fairly intuitive that they ought not be judged or even studied on the same grounds. If one were to instinctively compare the contexts of child and adult learning, one might think of child learning as oft formalised and disciplined, and adult learning as rather more ad hoc and sporadic. Reflecting on these differences was precisely what Knowles was trying to do when he suggested principles and a model for andragogy. It is worth noting that Knowles' model of andragogy went through various refinements over the years (Holton et al., 2008). I have chosen one of the latest versions to elaborate on here (see Figure 1, below).

In 1998, Knowles and colleagues settled on six differentiable characteristics of the adult learner: i) they want to know why they are embarking on a learning journey and what it might look like; ii) they are generally autonomous and self-directed; iii) their growing pool of experience over time and existing mental models become an important resource for learning; iv) they accept learning as a necessary part of assuming new tasks or social roles; v) they are problem-centred (rather than subject-centred), see learning as developing competence, and want to apply lessons learnt immediately; and vi) their motivations to learn are chiefly internal

rather than external (Holton et al., 2008; Knowles et al., 1998). The above list contains analytically useful *ideal types*²⁵ and general tendencies - rather than universally valid principles - that set the adult learner apart from the child learner (Holton et al., 2008).

Figure 1: Model of andragogy in practice (taken from Knowles et al., 1998)



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In the figure above, the six principles (or characteristics) of the adult learner are contained within the innermost ring. The middle ring presents factors which account for variations in the applications of the core principles across individuals: *subject matter differences*, *situational differences*, and *individual learner differences*. The outer ring presents different developmental objectives of adult learning, namely *individual growth*, *societal growth*, or *institutional growth*. The bidirectional arrows within each ring suggest that all the elements necessarily influence each other, implying that one should see the model as adaptable to specific contexts rather than transferable and/or exhaustive. The diagram can both be read

²⁵ A set of discernible characteristics shared by a given social group for analytical and comparative purposes.

from the inner ring to the outer ring or from the outer ring to the inner ring (this is in fact a subject of debate according to Holton et al. 2008).

The andragogy model has been criticised for its focus on the individual and on the transactional aspects of learning, at the expense of considerations of broader societal dynamics and of the (desired/undesired) outcomes of adult learning (Holton et al., 2008). Holton et al. (2008) mount a defence of Knowles, arguing that his approach to adult learning draws on humanistic (see Carl Rogers, Section 3.2.2) and pragmatist (e.g. John Dewey) philosophical perspectives - which emphasise the 'self-actualisation of the individual' and the 'knowledge gained from experience rather than from formal authority' (p. 123), respectively. They further argue that critical theories focused on learning outcomes are not incompatible with Knowles' andragogical model; they can be combined, as one focuses on the 'why' (i.e. motivations and outcomes of learning) and the other focuses on the 'how' (i.e. processes and conditions of learning) (Holton et al., 2008).

As I will develop further in this chapter, I also tend to embrace Knowles' focus on the 'how' and the philosophical influences he draws from, albeit from more of a methodological standpoint than a normative one. I nonetheless remain cognisant of the criticism levelled against such an approach to learning. For those reasons, I discuss why general agnosticism towards the outcomes (Section 3.2.2) and theories (Section 3.4) of adult learning - to begin with - might be a good strategy for studying science advisers' learning. Furthermore, while transformative learning also suffers from similar shortcomings to the andragogical model, my research project draws heavily on the theory of situated learning (Lave & Wenger, 1991), which shifts the gaze away from the learning processes within an individual to those within and between social groups or communities (see Section 3.3).

Another key difference I would like to highlight between adult and child learning environments, is the space that *tacit knowledge* - as opposed to *explicit knowledge* - occupies in the learning experience. Collins (2010) offers a simple definition of tacit knowledge, i.e. 'knowledge that is not explicated' (p. 1). Collins and other scholars in the social studies of science have demonstrated the importance of tacit knowledge in (collaborative) research in science and technology (e.g. Collins, 2010; Knorr-Cetina, 1999; MacKenzie & Spinardi, 1995), as well as in scientific apprenticeship and education (e.g. Becher & Trowler, 2001; Shankar, 2009). MacKenzie and Spinardi (1995) examine the striking example of nuclear proliferation, where a certain level of experimentation and trial and error was needed for countries like the Soviet Union, which - despite having the blueprint of the 'Christy gadget' (the solid-core design of the Trinity and Nagasaki implosion bombs) - still took four years to develop an atomic bomb.

Both they and Collins (2010) also refer to Polanyi's (1966) example of riding a bike. For MacKenzie and Spinardi (1995): 'when children are taught to ride, they are not given long lists of written or verbal instructions. Instead, someone demonstrates what to do and encourages them in the inevitably slow and error-ridden process of learning for themselves' (p. 45). They add that 'while observing others riding bicycles does not enable one to learn the skills of the cyclist, it nevertheless shows that cycling is possible' (MacKenzie & Spinardi, 1995, p. 81).

As knowledge that is acquired through socialisation and lived experience - and which cannot be communicated through explicit and codified means - tacit knowledge is closely related to learning by doing and learning with others. It emerges from a mix of observation and imitation on the one hand and individual experimentation on the other. Learning on the job is largely tacit (Berings et al., 2006; Pyrko et al., 2019). It has wide-reaching implications for studying adult learning both in live settings and retrospectively (Berings et al., 2006) - prompting at least two distinct and important questions for the researcher. Firstly, can the researcher access tacit knowledge (and its transfers) in real-time and, if so, through which methods? Secondly, can research participants retrospectively explicate knowledge that was previously tacit and how might the researcher then distinguish between the tacit and the explicit? Indeed, Collins (2010) suggests that inquiries into the nature of tacit knowledge are related to questions about the transfers between tacit and explicit knowledge. Although I do not set out to provide answers to these questions, I do nonetheless bear them in mind throughout the empirical analysis. Moreover, my research methods were selected partly on the basis of their potential to access and/or invite reflections on tacit knowledge, as explained in the ensuing sections.

3.2 Mezirow's transformative learning

Transformative learning has become somewhat of a buzzword in the world of sustainability scholarship. It has loosely been used to signify collective paradigm shifts and/or societal transformative changes. Part of my motivation for using it as a lens is to reaffirm and revisit its original conceptualisation in this academic space (see Obermeister, 2020). While there is some evidence that Mezirow was inspired by Thomas Kuhn's work on the structure of scientific revolutions, his theory of adult learning remains fundamentally about the individual (Kitchenham, 2008). Like Knowles' andragogy, Mezirow's transformative learning has been through various iterations (see Kitchenham, 2008 for an overview). Rather than pinpoint a specific version in time, as I did with Knowles, I have tried to pull together elements from the different iterations of transformative learning to (hopefully) build a cohesive and useful picture for this research project. In the later stages of theoretical development, Mezirow (2000) defined transformative learning as: 'the process by which we transform our taken-for-granted

frames of references (meaning perspectives, habits of mind, mindsets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action' (p. 8).

Mezirow uses the term 'meaning perspectives' as a label for the psychological and/or cultural frames of reference - based on past lived experience - within which we make sense of and assimilate new experiences (Kitchenham, 2008; Mezirow & Associates, 2000). Frames of reference are made up of *habits of mind* and 'resulting points of view' (Mezirow & Associates, 2000, p. 17). 'A habit of mind is a set of assumptions... that acts as a filter for interpreting the meaning of experience' (ibid.). They can be sociolinguistic, moral-ethical, epistemic, philosophical, psychological, or aesthetic (ibid.). Habits of minds are expressed as points of view. And points of view are composed of *meaning schemes*: the constellations of beliefs, judgements, and feelings that shape particular interpretations (Kitchenham, 2008; Mezirow & Associates, 2000). 'Meaning schemes commonly operate outside of awareness. They arbitrarily determine what we see and how we see it - cause-effect relationships, scenarios of sequences of events, what others will be like, and our idealised self-image' (Mezirow & Associates, 2000, p. 18). Taken together, meaning perspectives and schemes are called *meaning structures* (Mezirow & Associates, 2000).

When lived experience is compatible with the meaning structures one holds, the chances of transformations are fairly low - as new experiences can be assimilated into the existing meaning perspectives and schemes (Merriam & Clark, 1993). When, instead, an individual is confronted with a situation that is incongruent with existing frames of reference, they may experience what Mezirow calls *perspective transformation*: a transformation of meaning perspective or schemes through post hoc *critical self-reflection* (Kitchenham, 2008; Merriam & Clark, 1993). Reflecting on the different iterations of Mezirow's theory, Kitchenham (2008) reformulates the theory of perspective transformation as follows: 'the learner encounters a problem or anomaly that cannot be resolved through present meaning schemes or through learning new meaning schemes; the resolution comes through a redefinition of the problem. Transformation occurs by critical self-reflection of the assumptions that supported the meaning scheme or perspective in use' (p. 112).

In Mezirow's (2000) own words: 'we transform frames of reference - our own and those of others - by becoming critically reflective of their assumptions and aware of their context - the source, nature, and consequences of taken-for-granted beliefs' (p. 19). Perspective transformation can be seamless - if stretched over time - but it is often momentous and disruptive. It is in these moments of abrupt realisations that transformative learning can be

equated with the idea of a 'paradigm shift' at the level of the individual - echoing Kuhn's (2012) description of the 'goggles fitted with inverting lenses':

At the start [the goggle wearer's] perceptual apparatus functions as it had been trained to function in the absence of the goggles, and the result is extreme disorientation, an acute personal crisis. But after the subject has begun to learn to deal with their new world, their entire visual field flips over, usually after an intervening period in which vision is simply confused. Thereafter, objects are again seen as they had been before the goggles were put on. The assimilation of a previously anomalous visual field has reacted upon and changed the field itself. Literally as well as metaphorically, the person accustomed to inverting lenses has undergone a revolutionary transformation of vision (p. 112).

As an illustration of perspective transformation, allow me to use the relatively mundane example of how, being half-British, I might adjust to queuing practices abroad. In a first encounter of queuing in a cultural context where queuing is not considered a sacred microcosm of social order, my first instinct might be that people will queue with the same rigour as the British (meaning perspective), but to my surprise I find that is not the case. My reaction might then be consternation (feelings), a sense that they are doing things wrong (belief), and to debate myself whether I should do something about it or not (judgment). Transformative learning may or may not then occur in my example of queuing practices. On the one hand, I might choose to ignore the cultural differences and continue to expect British standards of queuing everywhere. On the other hand, I might critically reflect on the origins of my frustration and come to the realisation that I have been conditioned by my cultural environment and that I should be more tolerant of other cultural approaches to queuing. That transformation might be 'straightforward' or 'profound', depending on the level of critical self-reflection and the extent to which my meaning schemes and/or perspectives have changed as a result of this event.

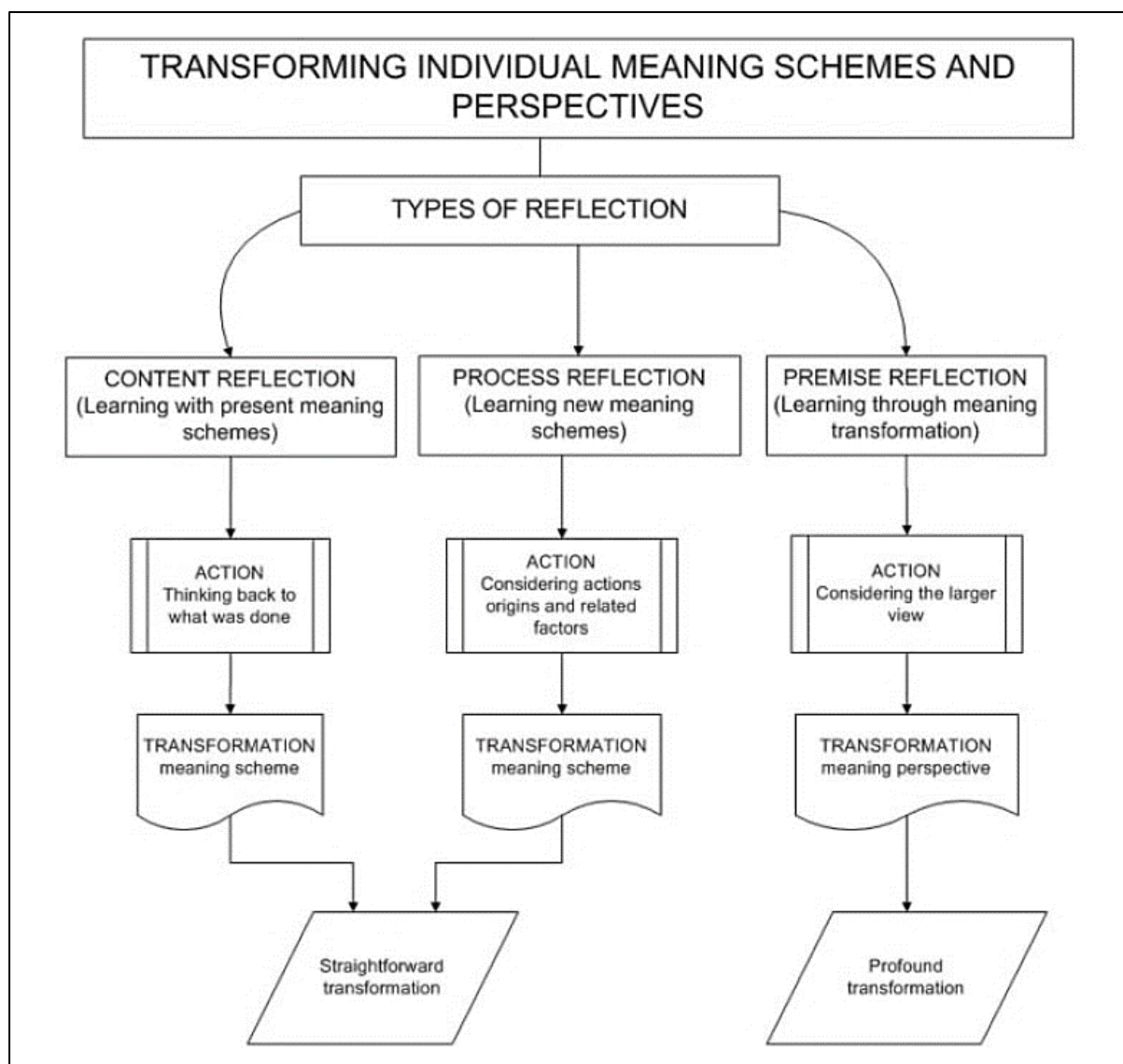
3.2.1 Straightforward transformation and profound transformation

In the 1990s, Mezirow refined the theory of transformative learning by making a distinction between the *straightforward transformation* of a meaning scheme and the *profound transformation* of a meaning perspective (Kitchenham, 2008). While straightforward transformation can be arrived at through either *content reflection* or *process reflection*, profound transformation can only occur through *premise reflection* (Kitchenham, 2008). Content reflection involves introspection about the outcomes of past events and recalibrating one's filters of interpretation to either replicate, adapt, or avoid such outcomes, whereas process reflection involves introspection about the context leading to those outcomes (ibid.).

By learning with existing meaning schemes - or by learning new meaning schemes without adopting a new worldview - the individual undergoes straightforward transformation.

Conversely, premise reflection involves introspection about all of the above and occurs when an individual reflects not only on the outcomes and context of an event but also the causes - questioning their interpretation of the event in the first place (ibid.). Premise reflection can lead to profound transformation; switching out spare parts is no longer enough, the whole machine needs changing. A diagram of the three types of reflection and associated transformation types can be found in Figure 2, below.

Figure 2: The three types of reflection with related actions and transformations (taken from Kitchenham, 2008, p. 115)



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As an analytical framework, transformative learning bodes well for the researcher. Mezirow's focus on critical self-reflection means that transformative learning is in many ways less of a tacit process than assimilation²⁶ (i.e. the incorporation of new information into pre-existing worldviews). The distinction between straightforward and profound transformation - and the associated types of reflection - is similarly helpful. Yet, some important methodological challenges remain. Some of those challenges pertain to access to and gathering of data in the first place, whilst others concern their analysis.

Once the researcher has collected qualitative data suggestive of some form of learning, what criteria might they apply to distinguish between learning that is transformative versus learning that is not? One strategy is to take a hard line with regards to Mezirow's theory and only consider learning to be transformative if it is associated with what he calls a *disorienting dilemma*²⁷: a discrete and disturbing event that shaped the individual's learning and is remembered as such (Kitchenham, 2008). In that case, and from a data analysis perspective, evidence of transformative learning might have at least two characteristics: i) an anecdotal incident that made a strong impression on someone and ii) indications of a change in mindset as a consequence. Consider the following fictional interviewee verbatim:

I remember very clearly sitting at the back of a lecture hall and the teacher was lecturing us on International Relations in the post-war period. Hum... something to do with the domino theory of communism. I can't quite remember, but anyway... I wasn't paying attention and I was chatting with the person sitting next to me, and then the teacher called me out in front of everyone. I was so embarrassed. What they did wasn't cool, but when the anger and shame settled down, I wondered why this kept happening to me, you know. I realised that I often brought it upon myself. Maybe it was just the rebellious teenager in me that had never left, haha! But yeah... from that day I tried to be more mindful of my share of the blame.

On the receiving end of this fictional story, the researcher might not have quite enough information to pronounce themselves on the degree of transformation - i.e. straightforward or profound - undergone by the interviewee (which is more often than not the case, as I discovered). However, the two aforementioned criteria are clearly fulfilled here: the event was disorienting, prompted (critical) self-reflection, and that reflection led to a change in the person's mindset. The above story would be suggestive of meaning perspective

²⁶ I am referring to Piaget's (1954) use of the word, not to the sociological definition, i.e. 'the process of members in a subordinate group adopting aspects of a dominant group' (Bell, 2013b).

²⁷ The disorienting dilemma is the first of the ten phases of transformative learning originally devised by Mezirow (see Kitchenham, 2008; Mezirow & Associates, 2000).

transformation, although there are still some elements missing for the researcher to be certain (e.g. whether or not the interviewee reflected on the causes of their self-inflicted behaviour).

In the event that no anecdote is provided, a researcher's strategy might be to just take - at face value - what the research participant says about their learning. There might be some instances where an interviewee spontaneously talks about the transformations they underwent, without connecting them to specific events or disorienting dilemmas. But what should the researcher - concerned with identifying transformative learning - make of instances where there is evidence of learning but there is no information suggestive of transformation or otherwise? One option would be to stretch the interpretative flexibility of the researcher, slicing either way based on the available clues. Another would be to categorise that data as learning that is not transformative.

I decided on the latter. Why? Because in my research, I am trying to understand the specific conditions of science advisers' transformative learning. Further research on the types of transformation undergone in different contexts might be of great value, but given the lack of previous empirical research on the subject, adding an extra layer of analytical complexity: i) risks negatively affecting the rigour of the empirical analysis; ii) would involve greater conjecture, compromising external validity; and iii) would be of questionable value with regards to pragmatic and useful recommendations. The methodological limitations of my research (discussed in this chapter and in Chapter 8) would - in any event - preclude me from making accurate judgments on the types and levels of transformations. Thus, by focusing on anecdotes and clear instantiations of transformative learning, my discussions of transformative learning remain at a relatively high level - without the full granularity of the theory, but more sound as a result.

3.2.2 Carl Roger's nondirective interview

Most of my data collection consisted of in-depth qualitative interviews. I borrowed from methods in *nondirective interviewing*, originally developed by the American humanistic psychologist Carl Rogers (1945). Influenced by psychoanalysis, and surprisingly similar to Elton Mayo's *nonauthoritarian interview* (see Mahoney & Baker, 2002), the nondirective interview is a form of unstructured interview which emphasises 'mirroring back' the interviewee's responses to questions - encouraging them to be more self-reflective and allowing 'the interviewee, rather than the interviewer, to assign significance to the topics covered in the interview' (Lee, 2011, p. 126). The nondirective interview is grounded in the assumption that the interviewee is most apt in exploring the problems at hand, through their own spectrum of thoughts and emotions (Michelat, 1975). The interviewer is then relegated

to the role of facilitator and must actively subscribe to a non-judgemental and accepting attitude vis-à-vis the interviewee (Mahoney & Baker, 2002; Michelat, 1975).

On paper, the nondirective interview has a few merits in trying to access and gain information on learning from research participants, and particularly experienced science advisers. Firstly, the unstructured and unfrontational nature of the nondirective interview offers the interviewee a great degree of freedom in taking the conversation in a direction of their liking - possibly increasing the levels of *self-disclosure* (Michelat, 1975; see Section 3.2.3). Secondly, unstructured or semi-structured interview methods are preferable in the context of elite and expert interviews as they give the interviewee 'the room... to unfold [their] own outlooks and reflections' (Meuser & Nagel, 2009, p. 31). Thirdly, by reiterating (or reformulating) an interviewee's train of thought, the interviewer invites them to reflect further on and/or reconsider something they said, which may then lead to greater reflexivity on behalf of the interviewee and ergo increase the interviewer's level of access.

As I quickly discovered in the application of the method, it is by no means effective in all instances but it has on occasion yielded surprising results: for example, interviewees might start talking about their learning without being asked about learning in any form whatsoever. Very early on in my interviewing process, I also learned that if I used any language that clearly came from me (e.g. academic jargon) or if I offered an opinion, the interviewees would subsequently engage on that level and then it would become very difficult to restore the 'oral history' type interaction offered by the nondirective interview. As a consequence and over time, I became increasingly proficient at navigating the fine line between naïve layperson and knowledgeable commentator - opting for naivety more often than not.

Beyond being flattering and empowering for interviewees who find themselves engaging in pedagogy (i.e. they feel compelled to explain things to you), it also genuinely helped to 'soften the effects of social distance between interviewer and interviewee' (Lee, 2011, p. 135). It also helped to present myself as non-threatening and trustworthy, although personal attitude and other aspects of an interviewer's positionality are likely to play a bigger role. In fact, in the case of *elite interviews*, Bogner and Menz (2009) suggest that by taking an explicitly 'layperson' position, interviewers can encourage monologues, and 'naïve' questions can be generative. In their typology, I strived to fall somewhere between the 'co-expert' and the 'layperson' (Bogner & Menz, 2009). By encouraging paraphrasing, the nondirective interview is particularly conducive to this type of interviewer positionality.

Another benefit of the nondirective interview (and other forms of unstructured interviews) is that by focusing less on a checklist of motions to get through, the interviewer's attention is

aimed at what the interviewee is saying and how they are saying it. Rogers (1945) himself suggested that a benefit of the nondirective interview was that when the interviewer concentrates 'on the attitude expressed, and upon their own reformulation of it in terms as accurate and fair as possible, the actual attitude [of the interviewee] is much more deeply impressed upon the interviewer than it is when they are listening to the [interviewee] with partial attention, trying meanwhile to decide what question [to] ask next' (p. 281). Moreover, notetaking can be kept to a minimum if the interview is recorded - freeing up even more cognitive capacity for the affective aspects of the interview, for example the significance of silence or hesitations (and body language if conducted in person) (Michelat, 1975).

Taken altogether, I would argue that the nondirective interview has the potential to offer greater access to interviewees' inner experience than semi-structured interview methods. In the context of my methodological design, the nondirective interview also fits well with the overall grounded theory approach of this research project, insofar as the interviewer is opening up the interview to unsolicited and unanticipated information and can revise the theoretical framework accordingly (Charmaz & Belgrave, 2015; Lee, 2011). See Section 3.4 for more information on the grounded theory approach of the thesis.

When it comes to interview transcription and analysis, Michelat (1975) suggests that those interventions that are inevitably directive, and associated responses, can be marked off with the use of brackets (advice that I diligently followed). In order to capture the affective aspects of the interview, the transcriptions of my interviews were pretty much word by word (including repetitions) and annotations for long pauses ([...]), short pauses and interruptions (...) and uses of humour (<h>) were used systematically throughout (as can be seen in Chapter 4, Figure 4). While the annotations of pauses were in the end of lesser value than anticipated, I retained the annotations of humour (<h>) for all verbatim and edited quotes in the empirical analysis. The significance of humour is discussed at various points in the analysis. Michelat (1975) also contends that each interview must be analysed in its own right (vertically) - preserving as much as possible the interviewee's stream of consciousness - but can also subsequently be compared (horizontally) with other interviews to draw out similarities and differences (Michelat, 1975). The latter first involves, as is the case in grounded theory (Böhm, 2004; Charmaz & Belgrave, 2015), the careful analysis of individual transcripts and a continuous adaptive iteration of the interpretative elements (e.g. codes) (Michelat, 1975).

My coding framework emerged from the analysis of a random sequence of interviews with experienced advisers²⁸, with no a priori thematic codes except for obvious ones such as 'transformative learning' or 'positions held', for example (see Appendix A for the final coding framework for interview data). All in all, both the nondirective interview and its analysis must be fluid and adaptive and in constant conversation with one another. It is precisely this kind of fluidity that I wanted to capture in the interview guide (that I called 'interview prompts').

As I progressed with the interviews, I made changes to the interview prompts based on the data that was emerging and on my personal reflections of what was and was not working (see Box 1 for the latest iteration and Appendix B for the initial version). To that effect, I kept an informal research diary, noting the things that worked well and those that did not after a few of the interviews. For my own learning and quality assurance, I also coded examples of good nondirective comments/questions. The interview prompts were not religiously stuck to but were certainly helpful to have at hand - especially in the case of very concise or disengaged interviewees.

²⁸ They were the first interviews that I conducted and transcribed. That may have introduced some bias for the analysis of interviews with early-career researchers, but equally had the benefit of offering a framework for comparison between experienced and less experienced advisers.

Box 1: Interview prompts (revised and final version)

Legend	
Experienced adviser ¹	Orange
Unexperienced adviser ²	Blue
Adviser with affiliation ³	Green

N.B. the categories of *experienced adviser* and *unexperienced adviser* should remain flexible. If, as the interview progresses, it comes to my attention that someone who might be categorised as unexperienced based on their curriculum vitae is in fact quite experienced, the prompts should be adapted accordingly. The opposite is unlikely to happen.

Orange	Blue	Green	Unexpected aspects of policy world
Orange	Blue	Green	Had an instinct for? Or Surprised?
Orange	Blue	Green	Culture of academia vs policymaking
Orange	Blue	Green	Role & traits of a 'good' adviser
Orange	Blue	Green	Diversity – network/membership/evidence
Orange	Blue	Green	Importance of reports / documents
Orange	Blue	Green	Conversations on the edges / outside meetings
Orange	Blue	Green	Questions I should have asked?
Orange		Green	Your 'perfect' science-policy interface / committee
Orange		Green	'Multiple hats' of the adviser
Orange		Green	Advice to younger self / do anything differently?
	Blue		Surprises / disappointments
	Blue		Challenges / compromises
	Blue		Take-home messages
		Green	Good chairmanship / leadership
		Green	Organisational culture & sense of belonging?
		Green	Meeting-specific questions (based on ethnography)

¹ Refers to those individuals who have extensive and/or in-depth experience in different advisory roles in the UK; defined here as at least two different appointments and/or several years within a single, prominent advisory role. Experienced should also understood as depth and type of engagement with specific advisory processes (e.g. Chairs will have a different experience). They may or may not be affiliated with the selected sites of study.

² Refers to early-career researchers with limited prior encounters with the policy world (in my case former UK policy interns).

³ Refers exclusively to those individuals who are either current or former members/affiliates of the selected sites of study.

When it comes to the specific purpose of studying advisers' transformative learning, the benefits of the nondirective interview are clearly manifold. Firstly, nondirective interviews are based on the idea of (critical) self-reflection (or *introspection*). They invite interviewees to consider increasingly more intricate interpretations of events and narratives, which is in keeping with a study of transformative learning relying on memorable anecdotes. Moreover, the nondirective interview can prompt reflections on learning without ever mentioning learning as an objective of the interview²⁹. Secondly, the agnosticism³⁰ and neutrality that comes with the positionality of the interviewer using nondirective interviews helps to build rapport, trust, and a non-judgmental stance increases the chances of honest and personal observations (as opposed the 'party line' for example). This is particularly important with elite interviewees, some of whom are used to giving interviews with researchers and/or the press. Thirdly, the mirroring back strategy can, in theory, help with the problem of *recollection* (discussed in Section 3.2.3, below), especially with more experienced advisers reflecting on the early days of their engagement. In Table 1, I summarise my take on the pros and cons of the nondirective interview for studying transformative learning. I focus on the issues of self-disclosure, recollection and introspection. Appendix D contains some reflections from the pilot interviews I conducted with one experienced adviser and one early-career scientist.

3.2.3 Self-disclosure, recollection, and introspection

Mostly as a consequence of COVID-19, the vast majority of my interviews were conducted online, via Skype or Microsoft Teams, and with the webcam off (for bandwidth reasons). I discussed the issues of trust and access earlier, but here I want to address some of the potential effects of conducting nondirective interviews online, instead of in-person, in terms of three key variables: *self-disclosure*, *recollection*, and *introspection*. I see the success of an interview on (transformative) learning as relying quite heavily on what and how much the interviewee is willing to share (self-disclosure), the honesty and accuracy of their stories (recollection), and the level of critical self-reflection (introspection). Because very few of my interviews were in person, I do not have many insightful, comparative thoughts to offer.

²⁹ The interview invitation letter was deliberately designed this way. It contained no mention of learning (see Appendix C).

³⁰ In an article I wrote, I argued that 'although approaches that adopt more critical or strategically antagonistic stances with respect to experts' learning in science-policy could be fruitful, I would contend that we first need to develop and test a range of empirical tools for studying advisers' learning, a task that requires a certain amount of agnostic experimentation, as well as inputs from a variety of disciplinary perspectives and geographies' (Obermeister, 2020, pp. 6–7).

However, from the perspective of conducting the research, online interviewing - particularly audio only - had several clear benefits.

For instance, by only having the interviewee's voice as an input, I was able to listen more deeply to what was being said, which was conducive to better nondirective interviewing (e.g. paraphrasing). Similarly, not having to invest so much effort in my interviewer persona freed up some cognitive space. In the nondirective interview, upholding interviewer neutrality necessitates that the interviewer does not betray (even inadvertently) their preferences and/or opinion in an interview. One concrete example of that task being easier online would be notetaking practices: writing a lot about one thing and putting the pen down for others can send some unwanted cues to the interviewee that some topics or opinions are more of interest to the interviewer than others - possibly distorting or skewing the interview too much in the direction of what the interviewer wants to hear rather than what the interviewee has to say. That is less of a problem in an online setting, especially with the webcam off.

Self-disclosure can be defined as 'the voluntary and verbal communication of personal information to a targeted recipient' and can be measured along three dimensions: *frequency* (the amount of disclosed information), *breadth* (the range of disclosed topics), and *depth* (the intimacy level of the disclosed information) (Nguyen et al., 2011, p. 103). It has often been assumed that self-disclosure is higher in virtual settings than in face-to-face conversations, but in their systematic review of the literature Nguyen et al. (2011) find that the empirical picture is rather mixed and inconclusive. Their review is of particular interest because it concentrated on disclosure between two individuals (dyads), setting aside online group interactions or fora (Nguyen et al., 2011). They reviewed the predictive value of five different theories with regards to self-disclosure levels in computer-mediated communication versus face-to-face conversations - looking at both experimental studies and survey-based studies (ibid.). The experimental studies reported higher frequency and depth of self-disclosure for computer-mediated communication than face-to-face, while the survey-based studies results were either inconclusive or pointed in the other direction (ibid.).

Of the theories in support of greater self-disclosure online than offline, *reduced cues theory* is worth expanding on. It stipulates that the absence of certain cues in computer-mediated communication (e.g. visual cues), as opposed to face-to-face contexts, can lead to greater disinhibition and hence self-disclosure. Reduced cues theory was empirically supported by a study of online communication between shy and non-shy adults - with and without webcams - which found that the observed asymmetry in self-disclosure between shy and non-shy adults vanished when the webcam was off (see Brunet & Schmidt, 2008). In another study, Joinson

(2001) randomly assigned dyads of undergraduate students to discuss a topic in either a computer-mediated or a face-to-face setting, and found that spontaneous self-disclosure was higher in computer-mediated interactions, especially visually anonymous ones (i.e. no webcam). A couple of my interviewees commented on the uncanniness of speaking to their screen without seeing me, instead most likely staring at my static Skype profile picture.

From the perspective of 'recollection' and 'introspection', a survey of literature in psychology and beyond surprisingly yielded no relevant results. I was astonished not to find any empirical research on the qualitative differences between online and face-to-face counselling, in general, let alone the effects on recollection and/or introspection. With the increasing ubiquity of online counselling and digital research methods, this picture might change quickly. The problem of recollection was encountered on different occasions in my research. Consider this quote from an experienced adviser in response to my (closing) question about what they would advise their younger self:

I hesitate because... well, I hesitate because I can't think of any advice I'd give, but then I don't want to appear smug <h>. So, I think the fault is with me now in not thinking up good advice, rather than my younger self being perfect or anything.

A faulty memory is perhaps the least problematic aspect of recollection. Scholars have pointed out that the narratives we tell about ourselves are always partial, including with the recollection of events. As Monrouxe (2009) suggests in their discussion of longitudinal audio diaries, 'although we experience events, the events themselves are not stories. We choose which aspects of those events we wish to convey and which to omit, we create plots from disordered experience and give meaning to events' (p. 82). This means that the stories of learning events presented by interviewees will be linear and often made consistent with the beliefs and mental models held at the time of the interview (R. Evans, 2013). Interviewees might also be explicitly articulating what they tacitly learn for the first time during the interview (there was evidence of this happening in a couple of instances). This is a common feature of biographical research, according to Stroobants (2005).

In reality, the processes leading to transformative learning are far from linear; they are messy, iterative, and likely frustrating. Those aspects can get ironed out or forgotten by the time of an interview. Given my reliance on recounted events for the identification of transformative learning, recollection is clearly a challenge. It is precisely for those reasons that I complemented interviews with an ethnographic study (see Section 3.3.2) and ran an experimental pilot of diary research (see Chapters 4 and 8). Other limitations of the nondirective interview are discussed in Chapter 8. In Table 1, below, I summarise the pros

and cons of nondirective interviews and of online interviews. Given the lack of academic literature, some of the entries on recollection and introspection for online interviews are conjectural, derived from my own personal observations over the course of the research project.

Table 1: Summary table of the pros and cons of the nondirective interview conducted online

		Nondirective interview	Online interviews
Self-disclosure	Pros	Can create an atmosphere of trust and a safe space to share. The level of freedom offered to the interviewee and the depth of self-disclosure appear to be correlated (Michelat, 1975), although this has been contested (see Lee, 2011).	Some evidence that self-disclosure is deeper and more frequent in an online setting, especially with the camera off (e.g. Brunet & Schmidt, 2008; Joinson, 2001).
	Cons	The indirect nature of the method and emphasis on neutrality means that targeted and repetitive probing is not an option.	The impersonal nature can work against building trust and some interviewees may feel less comfortable sharing personal information with an invisible stranger, although the evidence suggests that for strangers self-disclosure is generally higher online (Nguyen et al., 2011).
Recollection	Pros	Accompanying the interviewee's thought process and/or asking for clarifications or examples can - in theory - prompt the recollection of events.	Doing the interview from the comfort of their home might have some benefits for recollection (this is the advice given for oral history interviews, see Oral History Society, 2020)
	Cons	Interviewees are also free to tell the stories in the way they want the interviewer to hear them and will not be pushed to reflect on the messiness of their learning experience. *The freedom afforded to interviewees means that they may recollect events and thoughts that deviate from the	*The amount of attention the interviewee feels compelled to give the interviewer can be lower than in a face-to-face setting. This happened with one of my interviewees, who I could hear typing during our interview. The propensity for getting distracted can negatively affect recollection.

		research at hand - resulting in unusable data.	
Introspection	Pros	By constantly inviting the interviewee to elaborate further, the nondirective interview seeks to achieve greater self-reflection (Lee, 2011). *From my experience, it is proficient at triggering introspection and reflexivity.	*In some cases, the privacy of a room, could possibly allow the interviewee's mind to wander and relive certain events, unencumbered by various thoughts about the interviewer before them, for example. A deeper reflection on those events might then ensue.
	Cons	The nondirective is perceived by some as being problematically passive and fundamentally submissive - tacitly lending approval to interviewees' existing views (Lee, 2011). *That could possibly lead to no reflection at all and/or endorsement of views that ought to be challenged.	*The possible lack of rapport and trust that comes with having an invisible and/or virtual interlocutor might create barriers to greater introspection.

*Based on personal observations

3.3 Situated learning in communities of practice

3.3.1 Legitimate peripheral participation as an analytical tool

In approaching science advisers' learning, I needed a vocabulary or framework to account for the influence of the formal and informal institutions they advised within, as well as the influence of their peers, in shaping their learning. Having discussed transformative learning as my principle theoretical lens for individual adult learning, I now turn to a useful and widespread theory of social or relational learning, namely *situated learning* - or *legitimate peripheral participation* - developed by Lave and Wenger (1991). Based on their observations of various models of apprenticeship in different cultural contexts, Lave and Wenger (1991) conclude that learning is chiefly interrelational, practice-based, and occurs within social communities. This 'situated learning' happens within *communities of practice* (CoPs): 'groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly' (Wenger-Trayner & Wenger-Trayner, 2015, sec. 'What are communities of practice?').

These communities can be epistemic (Amin & Roberts, 2008; Pyrko et al., 2019). In such cases, through 'thinking together' members of (epistemic) communities of practice develop a shared identity around shared interests and common problems they seek to resolve (Pyrko et al., 2019). In doing so, they develop a 'shared repertoire' and erect *epistemic boundaries* - creating in-group/out-group dynamics based on specific knowledge. Pyrko et al. (2019) add that 'epistemic boundaries manifest through knowing, but are grounded in identity investment and a regime of competence negotiated by the local community which give a CoP its idiosyncratic character' (p. 484). This creates challenges when it comes to collaborations across CoPs: 'learning between different communities requires practitioners to be prepared to go through *acts of transformation as they seek to understand how knowledge from another community may fit within the context of their own work*, enriching and altering what they know. Such transformations can involve power tensions and hence can be highly political' (Pyrko et al., 2019, p. 485, emphasis mine). As I discuss in Chapter 5, this is manifest in the context of science and policy communities.

Beyond knowledge practices, Lave and Wenger (1991) discuss how social practices define and determine the contours of learning. Newcomers into communities of practice are socialised into these social practices, which can either be tacit or codified (Amin & Roberts, 2008). Lave and Wenger (1991) call this process of socialisation 'legitimate peripheral participation' (LPP). The position of newcomers' is peripheral to begin with, as they gradually move towards *full participation* (Lave & Wenger, 1991). The peripherality is legitimated by 'old-timers' and 'as a place in which one moves toward more-intensive participation, peripherality is an empowering position' (Lave & Wenger, 1991, p. 36). At the periphery, newcomers can learn by doing specific tasks and by observing more skilful colleagues. As Lave and Wenger (1991) explain, 'an extended period of legitimate peripherality provides learners with opportunities to make the culture of practice theirs. From a broadly peripheral perspective, [learners] gradually assemble a general idea of what constitutes the practice of the community' (Lave & Wenger, 1991, p. 95). While there can be some top-down instruction, Lave and Wenger (1991) see learning as largely an 'improvised practice'. In the transition from newcomer to old-timer, members of CoPs not only learn to adopt their norms and practices but also - in doing so - contribute to their 'reproduction and transformation' (Lave & Wenger, 1991, p. 55).

As an analytical tool, LPP shifts our gaze to individuals' relationships with the communities of practice they are a part of and the (largely) tacit knowledge they acquire within them. By

conceptualising learning as a form of *enculturation*³¹, Lave and Wenger (1991) emphasise the importance of culture in (adult) learning. LPP is not radically constructivist. Instead, it reminds researchers to pay attention to learning as an interplay between the individual and the community. In that interplay, both the characteristics of the community itself and the nature of the interactions contained within it will influence learning outcomes. Situated learning in CoPs becomes all the more relevant for studying adult learning because of its strong connection with the workplace and professional identity (as discussed in Section 3.1). I suggest we view the various 'institutions of advice-giving' (Jasanoff, 2005b) as communities of practice in the terms laid out here. LPP applied to the context of science advice suggests that how and what advisers learn is inextricably attached to where and with whom they learn.

3.3.2 An ethnography of institutions, meetings, and documents

The nondirective interview benefits from being consonant with the recognition of advisers both as individuals - with their own life stories and worldviews - and as members or affiliates of particular organisations, networks, and/or sociocultural groups. To that effect, the nondirective interview is helpful in drawing attention to the interviewee's embeddedness in particular sociocultural milieus (Michelat, 1975). However, given the interactional and social nature of situated learning, I judged it necessary to supplement, or complement, interviews with observations of the production of science advice in action. An anthropological paradigm for studying science advisory institutions is nothing new and was the approach taken by Bijker et al. (2009) in their study of the Gezondheidsraad (Health Council of the Netherlands), for example. Their research also involved interviews, the analysis of textual elements, and grounded theory. However, their study was more in-depth, spanned a much longer time than mine, and did not consider learning as an object of study. Through their longitudinal ethnography of the Council, they were able to access its 'backstage' and observe its 'stage management' strategies (Bijker et al., 2009; see Hilgartner, 2000).

For my methodology, I drew mostly from *ethnography of meetings* (H. Brown et al., 2017), supplemented by principles of Science & Technology Studies (STS) ethnographies (Hess, 2001), *ethnography of documents* (Shankar et al., 2017), *institutional ethnography* (e.g. Devault, 2006; Wright & Rocco, 2007), and *organisational ethnography* (e.g. Ciuk et al., 2018). Hess (2001) identifies some common features across STS ethnographies which are relevant to this project: i) 'informants' are not seen as passive and can actively collaborate with the ethnographer; ii) field sites are almost never remote, but are instead very much part

³¹ 'The process of an individual or group learning and adapting to the norms and values of a culture (or subculture) in which they are immersed (e.g. learning a new language or clothing style)' (Bell, 2013c).

of the social fabric; and iii) the sites can be very diverse (not just the lab) and can include conferences, archives, and so on.

More recently in STS, Shankar et al. (2017) called for a greater emphasis on ethnographies of documents and documenting. In other academic fields (e.g. archival studies), ethnographies of documents are relatively widespread and established (H. Brown et al., 2017; Shankar et al., 2017). They suggest that an ethnography of documents and documenting could begin by considering 'how acts of creating, managing, and using documents (reports, memos, legal records, etc.) serve as primary sources of socialisation and learning' (Shankar et al., 2017, p. 73). This is an approach that emerges in great part from the literature on legitimate peripheral participation and situated learning (Lave & Wenger, 1991; Shankar, 2009; Shankar et al., 2017). An ethnography of documents and documenting in STS can combine field observations, interviews, and document analysis to reveal how documents arise, circulate, and participate in the construction of groups, boundaries and work practices (Shankar et al., 2017). One could then undertake a comparative analysis with preexisting documents beyond the immediate site of study - and look at how they circulate - to reveal information about 'shared practices' (Shankar et al., 2017). I elaborate how I approached document analysis in Section 3.3.3, below.

Originally put forward by Dorothy Smith (1987) in her book *The Everyday World Problematic*, institutional ethnography draws from *ethnomethodology*³² to study how everyday individual experiences - mediated through work - are coordinated, organised, and shaped by institutional processes across multiple sites (Devault, 2006; Wright & Rocco, 2007). Organisational ethnography 'can be succinctly described as a particular type of ethnographic study, including its written representation, which is concerned with organisations and their processes of organising' (Ciuk et al., 2018, p. 271). Whereas institutional ethnographies are 'designed to reveal the organising power of texts, making visible just how activities in local settings are coordinated and managed extralocally' (Devault, 2006, p. 295), organisational ethnographies seek to provide a 'thick description' of organisations and the work that occurs within them - constantly problematising the mundane and the banal (Ciuk et al., 2018).

Drawing from all of the above, the chosen approach for this PhD project is one that can be qualified as an 'ethnography of meeting' (H. Brown et al., 2017). In practice, this involved

³² 'Ethnomethodology literally means "people's methods" but may be more fully translated as "the study of people's methods for making sense of the world". The central aim for ethnomethodologists is to describe and analyse the practical procedures that members use to make sense of the social world' (Bloor & Wood, 2011, p. 77).

sitting in on (virtual) meetings within my sites of study. Brown et al. (2017) point out that meetings have not received as much ethnographic attention as documents and that both approaches are largely compatible. Indeed, meetings are framed by particular documentary practices, but they also involve specific material objects and configurations (H. Brown et al., 2017). As the locus of collective decision-making, meetings are 'central to the life of formal institutions and many other organisations... [and are] instantiated through a range of typical forms including the gathering of committees and working groups, project meetings, stakeholder meetings, site meetings, annual general meetings, team meetings, and ad hoc or "informal" meetings' (H. Brown et al., 2017, p. 10). As in the case of organisational ethnographies, meetings can be seen as 'boringly, even achingly, familiar routines, including ordinary forms of bureaucratic conduct', yet they are equally 'specific and productive arenas in which realities are dramatically negotiated' (H. Brown et al., 2017, p. 11).

My ethnographic approach to meetings focused on understanding how individuals viewed their role(s) in meetings, how meeting formats shaped their interactions and learning, and how they worked together. I was particularly attentive to who was being enrolled in meetings, who spoke and got to speak, how the formal and the informal interlaced (e.g. what is happening at the 'edges' of the meeting), how 'advice' was (co-)constituted within the meeting, the explicitly discussed and the tacitly acknowledged, conflicts or dilemmas and their resolutions, individual U-turns, affective and linguistic elements, deployments of expertise, and the levels of boundary work.

Although more recent STS ethnographies have oft been multi-sited and lengthy - with an emphasis on reaching 'near-native competence' in the field site (Hess, 2001) - this project's ethnography was *short-term* (Pink & Morgan, 2013) and *focused* (Knoblauch, 2005). Indeed, there were compelling arguments for doing so. While these forms of ethnography fall 'short of full immersion', they have been endemic to most studies of work and organisations (Knoblauch, 2005; V. Smith, 2001). And although the fieldwork is then inevitably short and/or intermittent, such ethnographies need not necessarily be 'quick and dirty'; they can benefit from being more intense, intrusive, focused, and theoretically-engaged than traditional, longer-term ethnography (Knoblauch, 2005; Pink & Morgan, 2013). Whereas long-term ethnography involves a lot of 'hanging around' and is concerned with being 'accepted' in the field site, in short-term ethnography, 'the ethnographer seeks to implicate her or himself at the centre of the action, right from the start, and engages participants in the project with this intention clearly stated' (Pink & Morgan, 2013, p. 355). Finally, whereas in long-term ethnography, the dialogue with theory can happen towards the end of the fieldwork period or

at certain moments of review, short-term ethnography 'involves continually bringing theoretical questions into dialog with the ethnography' (Pink & Morgan, 2013, p. 357) - a project in line with grounded theory.

3.3.3 Ethnographic fieldnotes and document analysis

Emerson et al. (2001) suggest that even though fieldnotes are intended to be primarily descriptive, they can still include 'initial impressions' and other thoughts. Following their advice, I decided to use an annotation method, originally suggested by Schatzman and Strauss (1973), to distinguish between the different types of observations: ON for observational notes, TN for theoretical notes, and MN for methodological notes (as cited in Emerson et al., 2001, p. 368). This is in line with the idea of 'ethnographic-analytical-theoretical dialog' suggested by Pink and Morgan (2013, p. 353) for short-term ethnographies. In terms of other annotations, I used '~' to signal inscription (approximate paraphrasing) rather than transcription (verbatim), ↻ for things to look into subsequently, and noted instances of humour with '<h>' (just like the interview transcripts). I piloted these annotation methods in the context of an international science-policy meeting. In this research project, the methodological notes (MN) served as an ongoing reflexive diary that helped sharpen my observations and related notetaking strategies, and the theoretical notes (TN) were useful reminders of my in situ thinking when it came to the analysis. See Box 2 for a redacted diary excerpt, below.

Box 2: Redacted ethnographic diary excerpt from a one-on-one meeting (names replaced by Academic and Civil Servant)

ON: Body language is relaxed for the most part. Academic is making everyone feel comfortable from the start.

ON: Academic = can't imagine we won't need CCS (Carbon Capture & Storage)

"it's a shitload of trees" <h> (we'd need to plant)

Maybe planting trees isn't the future – solar in deserts(?)

ON: I changed my own body language to mirror theirs

ON: Civil servant = "thing that's difficult" + "lots of kinds of politics involved"

Too hard to get rid of e.g. agri, cement, chemicals, etc.

Says their working on [TOPIC] at the moment

Back to one of the research questions (i.e. questions submitted to CSaP ahead of the meetings)

"How do we make sure we are not decimating those industries?"

Academic = "massively makes sense" in response to "does that make sense [about the trade-offs]?"

Without incentives, innovation can't happen

Some pressure to transform industries + need to set some deadlines against exempting some industries

MN: Academic looking at me to make me feel included; hard to be a neutral observer

[REDACTED SENSITIVE CONTENT]

TN: Remarkable that Civil Servant asked Academic about how to make the case to politicians

ON: Academic = "make sure the winners can succeed"

Tory gov would like that kind of business mindset

TN: use of examples widespread in this conversation as well

ON: Academic = ~"just throwing ideas some of which will be rubbish" <h>

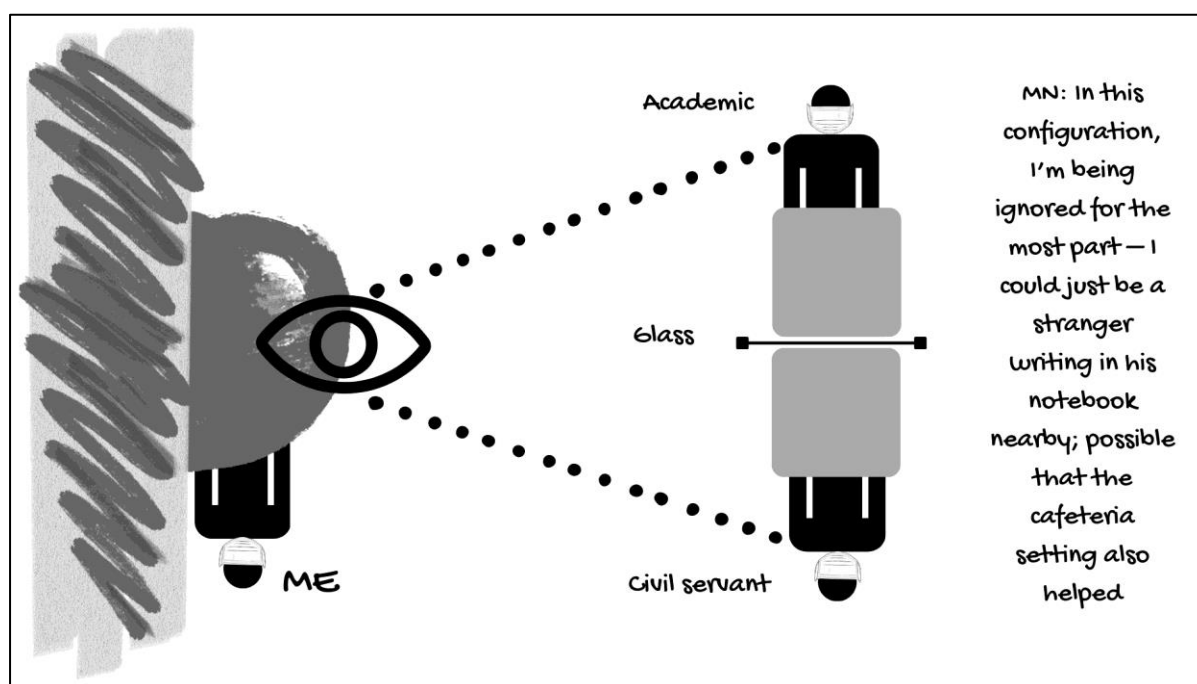
Another piece of advice from Emerson et al. (2001) concerns how research participants perceive the ethnographer. They argue that if you take detailed notes as the event is happening, research participants are likely to view you as an avid note-taker and will slowly stop paying attention to the notetaking per se (Emerson et al., 2001). This was only relevant in the case of the face-to-face meetings with the Centre for Science and Policy (CSaP) Policy Fellow (see Chapter 4), as for online meetings I had my camera switched off. It probably also helped that, in the framing of the research project, I offered research participants to share some of my notes as meeting 'minutes' (none of whom followed up on that offer).

In the original design of this research project, I had set out to take pictures or use sketching to capture the material circumstances of meetings. In one sense, material settings are *performative*. For example, they can be performative of the type of interaction (e.g. level of formality), the relations between meeting participants (e.g. roles, power dynamics, etc.), or even - in the context of science-policy - of the independence/dependence of science advisory groups. By way of illustration, up until 2008 the Royal Commission on Environmental Pollution (and its Secretariat) had successfully resisted being hosted within a government department building despite changing location thrice (Owens, 2015). Relatively soon after moving into Whitehall in 2008, the Commission was axed in March 2011 (see Owens, 2015 for more on how the move and demise of the Royal Commission were ultimately linked).

In another, and perhaps more important sense, material configurations define the possibilities and limits of what meetings can cover (remit) and achieve (impact), as well as of organisational learning and learning within organisations (Pallett & Chilvers, 2015). This could be as simple as the financial resources at an organisation's disposal or as complex as the material foundations of an organisation's culture (e.g. the effects of office locations). I return to the importance of these sociomaterial circumstances for learning in Chapter 7.

Sociomaterial factors might also affect how research participants view the ethnographer. In one particular meeting held in a public space, I felt relatively invisible thanks to the configuration and purpose of the space (see Figure 3 for the sketch). However, with online meetings the 'material' configurations are more binary and/or controlled, i.e. camera on or off, display only participants with video or all participants, spotlight some participants or view them all at all times. That made for much less insightful fieldnotes than would have been the case with face-to-face science advisory meetings. I nonetheless tried to analyse the significance of online functionalities and their effects on meeting practices in Chapter 7.

Figure 3: Sketch from CSaP ethnographic diary, set in the Judge Business School cafeteria and adapted from a hand sketch (MN refers to a 'methodological note')



My fieldnotes were first taken in a virgin notebook and then transcribed digitally as soon as possible following the meetings. That helped me familiarise myself more closely with the data and ensure that the fieldnotes were crystal clear for the analysis stage. Moreover, in the grounded theory approach, ethnographers qualitatively code and analyse the fieldnotes - treating them as a corpus of primary data (Emerson et al., 2001). So, it was necessary to

have the fieldnotes accurately transcribed digitally. Before each meeting, I would have a look at a word document that I wrote for myself as a reminder of the top-lines and to-dos (see Appendix E).

With regards to the document analysis, I studied any documents that informed the 'observed' meetings, typically the agendas and information documents circulated beforehand. In the case of the Department for Environment, Food & Rural Affairs' Science Advisory Council (Defra SAC), I also analysed some published minutes from previous meetings. The document analysis was congruent with the various ethnographic approaches to documents and documenting described above. As for most of my data, I followed a broadly 'conventional', inductive approach to qualitative content analysis - in line with grounded theory (Hsieh & Shannon, 2005; Prior, 2008). So, while the ethnographic observations were concerned with the practices of documenting (e.g. Shankar et al., 2017), the document analysis focused on the content and framing of those documents and, when possible, the rationale and conditions of their production. The ensuing analysis was partly discursive (e.g. rhetorical) and partly behavioural (e.g. affect). For each site of study, the data from ethnographic fieldnotes, interviews, and document analysis were *triangulated*³³. See Chapter 4 for more information on the sites of study research and Chapter 7 for the empirical analysis.

3.4 An analytical framework based on informed grounded theory

As I have mentioned several times in this chapter, the overall approach I took towards the data was one of grounded theory. Used widely in education studies (Thornberg, 2012) and psychological research (Henwood & Pidgeon, 2003), grounded theory is popularly known as 'letting the data speak for itself'. As Charmaz and Belgrave (2015) explain: 'the name "grounded theory" mirrors its fundamental premise that researchers can and should develop theory from rigorous analyses of empirical data. The analytic process consists of coding data; developing, checking, and integrating theoretical categories; and writing analytic narratives throughout inquiry' (p. 1). The method was first described by Glaser and Strauss (1967) in their book *The Discovery of Grounded Theory: Strategies for Qualitative Research*. They argued that theory could be derived inductively from qualitative data and that deductive reasoning from existing literature imposes 'preconceived ideas on the data, instead of

³³ 'Refers to the practice of using multiple sources of data or multiple approaches to analysing data to enhance the credibility of a research study' (Hastings, 2010, p. 2). In this case, it involved both 'methodological triangulation' (e.g. using multiple methods) and 'data triangulation' (e.g. using and comparing multiple sources of data) (see Hastings, 2010). Combining different methods 'enables the researcher to capitalise on the strengths of each approach and reduce the impact of the weaknesses inherent in a single approach' (Hastings, 2010, p. 3).

analysing them afresh' (Charmaz & Belgrave, 2015, p. 1). Some grounded theorists (most notably Glaser but not Strauss) go so far as to argue that a literature review should be delayed until the empirical analysis has been carried out; something that other grounded theorists find problematic (Thornberg, 2012).

I agree that there are many reasons why completely ignoring the literature before designing empirical research is both unfeasible and undesirable (see Thornberg, 2012). Thornberg instead speaks of *informed grounded theory* (2012), where the 'product of a research process as well as the research process itself... have been thoroughly grounded in data by grounded theory methods while being informed by existing research literature and theoretical frameworks' (Thornberg, 2012, p. 249). Here, I join Thornberg (2012) in their criticism of the largely positivist leanings of early grounded theory and the recognition that 'neither data nor theories are discovered, but are constructed by the researcher as a result of their interactions with the field and its participants' (Thornberg, 2012, p. 248).

In their paper, Thornberg (2012) breaks down the philosophy of informed grounded theory into some necessary steps. The suggested principles align well with my reasoning on using grounded theory for this research project. The first principle, borrowed from Henwood & Pidgeon (2003), is *theoretical agnosticism*: 'a critical stance toward pre-existing theories and research findings throughout the research project' (Thornberg, 2012, p. 250). Theoretical agnosticism complements my general agnosticism towards the normative outcomes of advisers' learning. And given the lack of existing empirical research on (transformative) adult learning in the fields of STS and human geography, as well as neighbouring fields (including sociology), there was very little material upon which I could have based my research design and theoretical framework. A multidisciplinary approach was therefore not only desirable, but also necessary.

Thornberg (2012) additionally speaks of *theoretical pluralism*. Pluralism is enabled by agnosticism towards theory; the researcher's attention is focused on finding theories that help best account for what they observe in the data at hand. Pluralism is then achieved through *theoretical sampling* (Thornberg, 2012) which involves surveying diverse academic literature as the empirical analysis unfolds. I did this systematically as new ideas emerged from the data analysis (Chapter 5 is a good illustration of this process). In doing so, I drew on research that I would never have encountered otherwise. Some of the research in those fields was also confirmatory of the methods I had chosen to adopt, providing some external validity with regards to research design.

All of the above must be achieved while *staying grounded* (Thornberg, 2012); the main focus remains the data and all emerging concepts and ideas should link directly with the data. The difficulties associated with deriving data on learning (discussed at great lengths in the context of the nondirective interview) means that top-down impositions of theories would only increase the amount of conjecture and speculation. I therefore deemed a low-level, bottom-up approach to my data to be essential. Dealing with the data at such a low level then requires some *theoretical playfulness* (Charmaz, 2006, as cited in Thornberg, 2012). Theoretical playfulness is a shorthand for creative thinking and flexibility with regards to the conceptual interpretations of empirical data (Thornberg, 2012). For these grounded theorists, it is important that researchers retain the option to explore and experiment with different conceptual ideas, inspired by the pluralism and enabled by the agnosticism described above (ibid.). This constant conversation between data and theory is achieved by *memoing extant knowledge associations* and *constant reflexivity*, according to Thornberg (2012). The former means recording the ideas that emerge from looking at the data. I built this into the design of my interview coding and ethnographic fieldnotes strategies. My coding process for interviews and other materials are described in more detail in Chapter 4.

Regarding the latter, I strove for constant reflexivity at all stages of the research - for example through the annotation methods for ethnographic fieldnotes and the systematic coding of good nondirective questions for continuous improvement. I also kept a research diary where I wrote down some of the positives and frustrations following particularly enlightening or challenging interviews, and captured some emerging conceptual ideas. All in all, there were many intentional and fortuitous synergies between the methods used for data collection and the chosen analytical framework. The next chapter explains their operationalisation with my research participants and in the sites of study, while a reflective discussion on limitations encountered can be found in Chapter 8.

4 Data collection, analysis, and sites of study

In this chapter, I provide the details of the data collection which took place between September 2019 and March 2021. It is broken into three parts: i) the nondirective interviews; ii) the ethnography of three sites of study; and iii) the experimental pilots of diaries and a simulation. As they were experimental pilots and the data was not used for the empirical analysis (i.e. Chapters 5 to 7), the results from the analysis of the diaries and simulation of a scientific advisory committee are discussed in Chapter 8. Here, I just present what I did and why.

4.1 Nondirective interviews

I conducted a total of forty-two interviews with thirty-nine interviewees. With the exception of the interviews with my three diary participants, all interviews were conducted only once, and due to various COVID-19 lockdowns, only six interviews were conducted face to face. A majority of interviewees (twenty-four) were *unaffiliated advisers*, meaning they were not current or former members of the Department for Environment, Food & Rural Affairs' Science Advisory Council (Defra SAC) or Hazardous Substances Advisory Committee (HSAC), nor were they academics consulted by the Centre for Science and Policy (CSaP) Policy Fellow I followed³⁴. *Affiliated advisers* amounted to twelve experienced advisers. Former UKRI Policy Internships interns accounted for ten of the thirty-nine interviewees. I sometimes refer to them as *less experienced advisers* throughout the monograph. Every single one of them had completed a placement which lasted between three and six months, less than two years prior to the interview³⁵, and in environment- or climate-related work.

Of the (unaffiliated and affiliated) experienced advisers I interviewed, six were former Chief Scientific Advisers (CSAs) for the government or a Devolved Administration (DA) in departments related to environment and/or climate change. For a breakdown of interviews and additional information on their average length, as well as the gender distribution of interviewees, see Table 2 below. It is worth noting that the gender imbalance for experienced advisers is more or less representative of the underrepresentation of women in the science advice space in the 1980s and 1990s (i.e. when most of the experienced advisers I interviewed started getting involved).

³⁴ This does not mean that the unaffiliated advisers had no exposure to these organisations. In fact some of them had (as part of the CSaP network, for example), but not as members of either committee.

³⁵ Most of them had completed their internship less than a year prior to the interview. This was a deliberate sampling strategy on my behalf, because of concerns related to accurate recollection.

Table 2: Breakdown of interviews

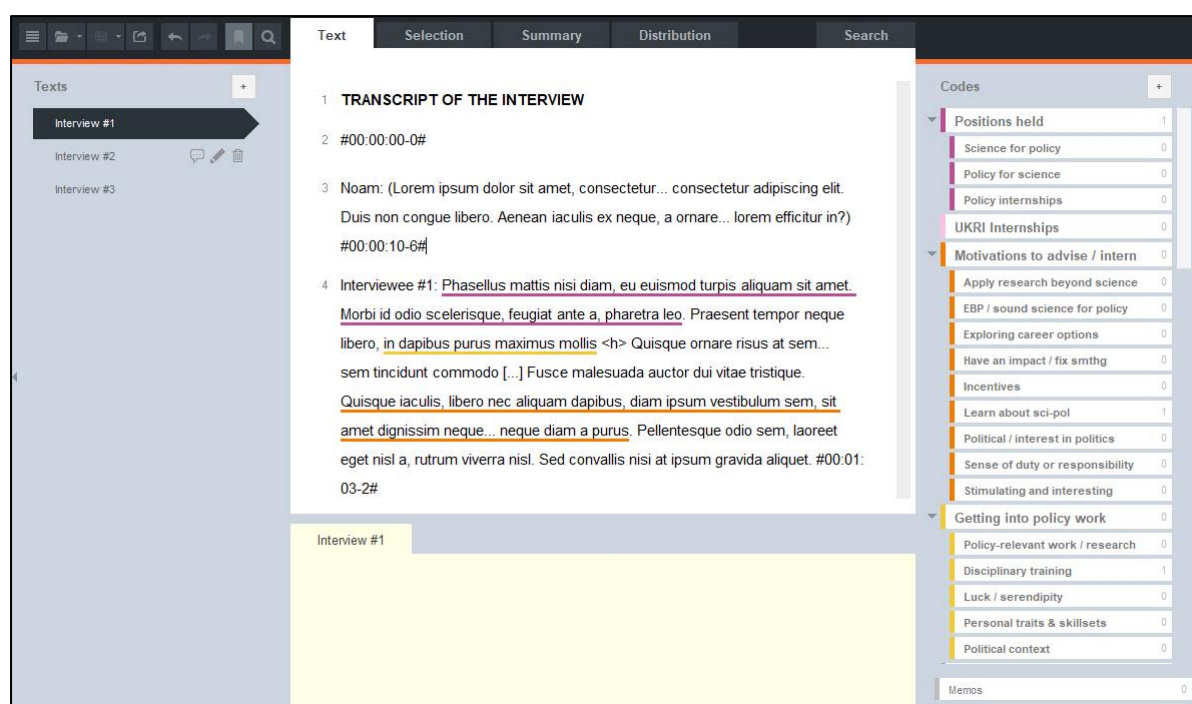
Type of interviewee	Number of interviewees	Gender balance	Average length of interviews
Experienced advisers (unaffiliated)	14	33% female; 67% male	55 minutes
Former UKRI Interns	10	60% female; 40% male	40 minutes
Current or former Defra SAC members	9	45% female; 55% male	45 minutes
HSAC member	1	Not disclosed for anonymity	40 minutes
CSaP academics	2	100% male	55 minutes
Diary participants*	3	33% female; 67% male	35 minutes
Total	39	41% female; 59% male	45 minutes

* Interviews were repeated once (i.e. a total of 6 interviews)

Across the board, interviewees came from a large range of disciplines, with the dominant disciplines being variations of zoology and ecology. In general, there were more natural scientists than physical and social scientists. Roughly one-quarter had a background in social sciences. Depending on the definition, possibly none had a background in the humanities. The organisations my research participants had engaged with covered a significant swathe of the UK science-policy ecosystem on environmental matters. The organisations included numerous scientific advisory committees (e.g. the Committee on Climate Change and the late Royal Commission on Environmental Pollution), government departments (e.g. the now combined Department for International Development and Foreign & Commonwealth Office), non-ministerial government departments (e.g. the Food Standards Agency), non-departmental public bodies (e.g. Natural England), learned societies (e.g. the British Ecological Society and Royal Society), parliamentary organisations (e.g. the Parliamentary Office of Science and Technology), research funding organisations (e.g. the Natural Environment Research Council), and intergovernmental organisations (e.g. Intergovernmental Panel on Climate Change and the European Commission). For the preservation of anonymity, I generally avoid naming affiliations beyond those directly relevant to the empirical analysis; i.e. Defra, the Department for Business, Energy & Industrial Strategy (BEIS), and the three sites of study.

Most interviewees were recruited via email. Each email had as an attachment a letter (Appendix C) which outlined the objectives of the research project and which deliberately omitted mentions of learning. A consent form (Appendix F) was also attached to the email. I included the consent form in the initial emails to potential research participants, because it outlines my approach to data protection, confidentiality and anonymisation. Both the letter and the consent form were designed to inspire trust. All interviews were recorded and transcribed shortly after. With the exception of the diary participants, I transcribed them myself using f4transkript³⁶, with the annotations discussed in Chapter 3. Interview and ethnographic data were coded in f4analyse³⁷ using the informed grounded theory approach laid out in the previous chapter. The emergent codes were in part used to structure the empirical analysis. For instance, the thematic code called 'two cultures' was the foundation of Chapter 5. Figure 4, below, is a screenshot of what coding looked like in f4analyse.

Figure 4: Snapshot of the f4analyse coding software and the coding process



The left panel contains the list of interview transcripts and/or documents. When a document is selected, the text appears in the central panel and is modifiable. The right panel contains the coding framework. Each header code has a set of subcodes with the same colour. Some data points were coded in different codes (i.e. they had multiple colours). When data points did not match any of the sub-codes available, they were coded into the header code. In subsequent iterations of the framework, a new sub-code might then be created to house those

³⁶ <https://www.audiotranskription.de/en/f4transkript/>

³⁷ <https://www.audiotranskription.de/en/f4analyse/>

data points. Each header code had an associated explanatory note (not visible here) called a 'code comment'. Code comments serve to provide details on what each code means and what sort of data it may encapsulate. They were, of course, also subjected to changes in the different iterations of the coding framework.

In line with the grounded theory idea of memoing thoughts along the way (Böhm, 2004; Charmaz & Belgrave, 2015; Thornberg, 2012), the software provided two useful tools. First, in the yellow box (bottom centre), notes on the selected interview transcript or document can be recorded (they are connected with the individual document, rather than the coding framework). As I went along, I would systematically capture thoughts on the overall interview, and particularly on the interviewee's personal (learning) journey. Second, the memo function - visible on the bottom right of the screenshot - allows the user to attach written comments to specific sections of the text (separately from their codes). In the memos, I would generally summarise promising passages and record related thoughts (sometimes theoretical ideas). The memos proved to be the most important source of inspiration and information for the empirical analysis (Chapters 5 to 7). The final coding framework for all interviews can be found in Appendix A.

4.2 Ethnography

4.2.1 Defra's Science Advisory Council (Defra SAC)

The Department for Environment, Food & Rural Affairs' Science Advisory Council (Defra SAC) is a non-departmental public body which advises Defra and its CSA on science-related issues. According to its website, the objectives of SAC are to: i) 'advise and support Defra on developing and implementing an effective and efficient strategy for obtaining and using evidence and scientific advice'; ii) 'advise on and provide assurance on the process for evidence gathering'; iii) 'provide strategic oversight and assurance on how evidence is used in policy, providing targeted support where necessary'; iv) 'provide constructive challenge on Defra's evidence'; and v) 'identify sources of additional expert external advice to input to Defra evidence' (Defra, 2022a, sec. 'Objectives'). It is composed of a multidisciplinary group of eleven members and any potential conflicts of interest are recorded and published online (see Defra, 2022d for the latest version). One of the members acts as Chair. The Chair - in conversation with the CSA and the Secretariat - is actively involved in setting the agenda for SAC meetings.

SAC meets for long meetings (traditionally face-to-face) three to four times a year and meets for several shorter meetings throughout the year, as deemed necessary. SAC has a

comprehensive 'handbook' which lays out its role and remit, operations, code of conduct, and much more (see Defra, 2015). Select aspects of the handbook are discussed in the context of my analysis in Chapter 7. Most importantly - as it sits at the top of the science advice food chain - SAC is a strategic, high-level advisory committee. For highly technical scientific matters, SAC occasionally appoints time-limited sub-groups which can include experts from outside of the Defra advisory ecosystem (see Defra, 2022a, sec. 'SAC sub-groups'). Each sub-group is chaired by a SAC member. Some sub-groups are standing, such as the Social Science Expert Group (SSEG), which acts as the social science arm of SAC.

I contacted the Defra SAC Secretariat in February 2020. After a conversation with Secretariat members and the green light from SAC's Chair, I attended three (virtual) meetings in 2020 - two long meetings (four hours) and one short meeting (one hour). In the first meeting I was invited to introduce myself, but thereafter proceeded to switch off my camera and mute my microphone. Invitations to interview were sent to SAC members after the first meeting and the observations of that first and subsequent meetings were occasionally used in those interviews. Before each meeting, I coded the meeting agendas provided by the Secretariat. Unfortunately, discussion papers were not provided (unlike HSAC). That analysis informed the ethnography. I also conducted a targeted analysis of the available published minutes, agendas, and discussion papers of five meetings held between June 2018 and February 2019. The rationale for doing so was to see how SAC's role and contributions were represented in those documents. To do so, I used a very simple regular expression (RegEx) in MAXQDA: 'SAC' followed by three words³⁸, and exported the results to a spreadsheet. The Defra SAC analysis, in Chapter 7, is the result of a triangulation of all of the above.

4.2.2 Hazardous Substances Advisory Committee (HSAC)

The Department for Environment, Food & Rural Affairs' Hazardous Substances Advisory Committee (HSAC) is 'an independent scientific advisory body providing expert advice on protecting the environment, and human health via the environment, from potentially hazardous substances, articles, and wastes' (Defra, 2020b, p. 2). According to its terms of reference, this includes advice on 'matters of relevance at a domestic, European and global level', the 'assessment of risks', and the 'research needs and other gaps' with regards to 'potentially hazardous substances, articles, and wastes, including advanced materials' (ibid.). The terms of reference further specify that HSAC can be asked to provide advice on 'policy development and evaluation, including the impact of different policy options' (ibid.). HSAC had

³⁸ In MAXQDA the query was: SAC * * *. This can be expressed as follows in RegEx: (\bSAC\b \w* \w* \w*).

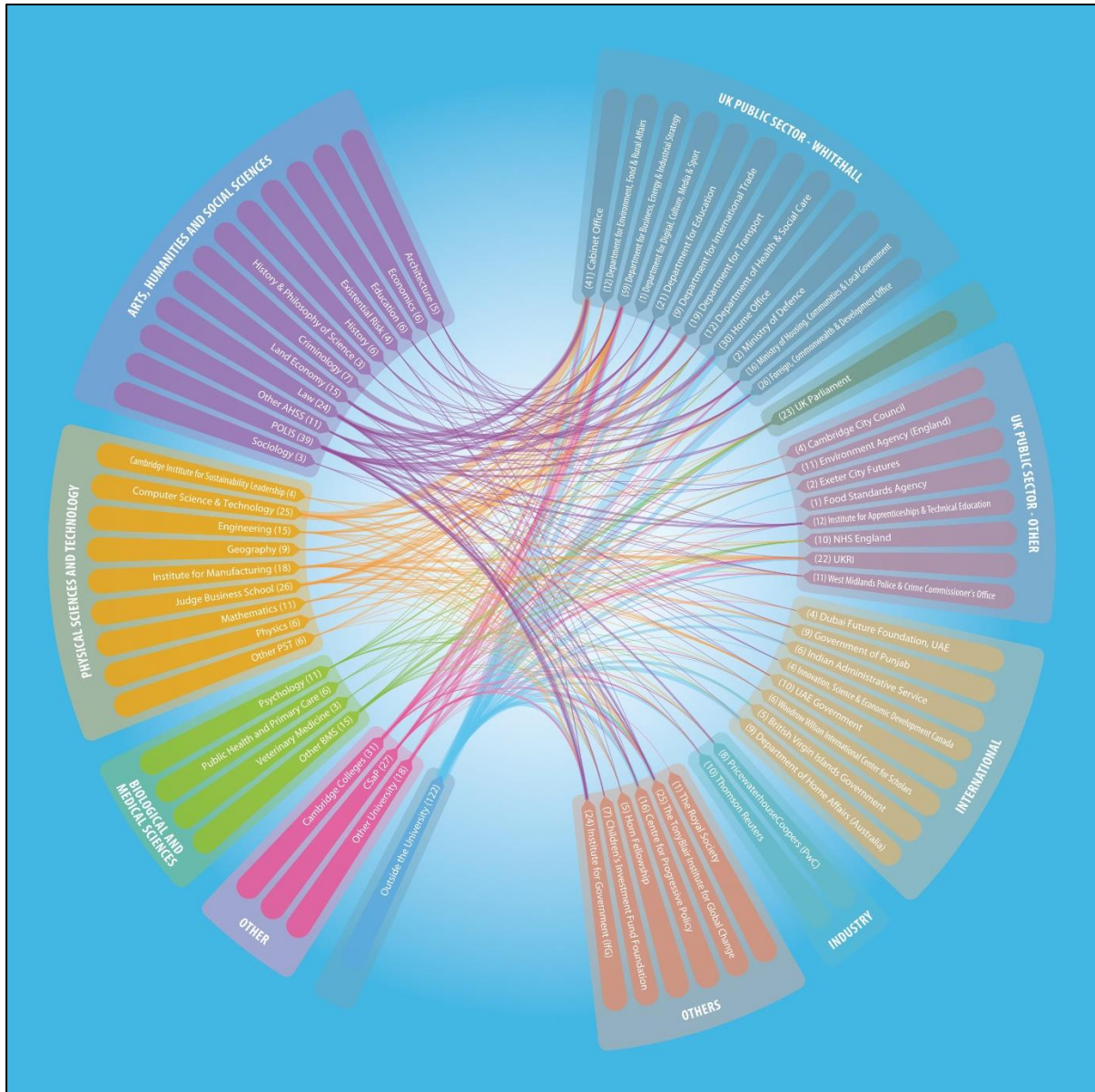
eight members at the time of my research and currently has ten, most of them coming from the fields of environmental chemistry and/or toxicology. Interestingly, of the ten current members, three are tagged as 'early-career researchers' in the official list (see Defra, 2022c).

Unlike SAC, some of HSAC's meetings are open to the public and the Secretariat publishes online some of the materials circulated to members and observers ahead of meetings (which seem to be unedited for the most part), including the meeting agendas (Defra, 2022b, sec. 'Minutes and papers'). A declaration of interests is required from HSAC members, as per the code of practice (see Defra, 2020a), but does not appear to be available online. My analysis of HSAC was based on: observations of a two-hour meeting, including an analysis of its agenda and the meeting documents circulated beforehand; an interviewee with one of the HSAC members at the time; and informal conversations with a member of the Secretariat and another member of the committee.

4.2.3 Centre for Science and Policy (CSaP)

The University of Cambridge's Centre for Science and Policy (CSaP) is an institutional knowledge broker with affiliations to the University, but also its own governance and revenue sources. The Centre's mission is 'to improve the quality of policymaking through promoting the more effective use of evidence and expertise' (CSaP, 2022b, p. 2 of the PDF). CSaP claims to 'forge relationships based on mutual understanding and trust, and build networks of people who share values of intellectual curiosity and public service' (ibid.). CSaP has many activities, but its flagship programme is the Policy Fellowship Programme which connects elected Policy Fellows (generally UK civil servants) with a network of academics at Cambridge and at partnering universities. A Policy Fellow (PF) typically spends a couple of days in Cambridge meeting academics. CSaP organises the visits, including the identification of relevant experts based on the PFs' stated interests. The connections they help build through this programme is represented visually in their annual reports (see Figure 5 below). The latest annual report states that since the launch of the programme in 2011, 'more than 460 Policy Fellows and alumni have benefited from over 10,900 meetings with more than 1700 researchers' (CSaP, 2022b, p. 9).

Figure 5: A visual representation of meetings between Policy Fellows and academics between 2020 and 2021 (taken from CSaP, 2022b).



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For my research, I only got the approval of one PF - from the Department for Business, Energy & Industrial Strategy (BEIS) - to follow them in their two-day visit. This was partly because of various COVID-related delays (i.e. PFs pushing back their visits). Of the ten planned one-on-one meetings, I attended seven. Two of the academics the PF met agreed to a follow-up interview. I also had a few informal chats with a CSaP member of staff and a couple of the experienced advisers I interviewed had experience with CSaP. I draw on all of these data points in the analysis in Chapter 7.

4.3 Diaries

Diary research was originally going to play a much bigger part in the data collection. Diaries are mostly used in medical and health research (see Furness & Garrud, 2010; Monrouxe, 2009). They can provide the researcher with 'thick' descriptions and interpretations of the day to day and important life events, over long periods of time, and hence address some of the issue of recollection discussed in Chapter 3 (Furness & Garrud, 2010). They work well in conjunction with other qualitative methods (Berings et al., 2006). In their review of methods for studying 'on-the-job learning', Berings et al. (2006) state that 'diary studies seem to be useful in understanding how people learn in interaction with their social context, and in relation to what they have learned' (p. 352). In addition to capturing data on situated learning, diaries can also act as 'reflection journals': a pedagogical tool used by students to think through their formal learning (Lew & Schmidt, 2011). By encouraging self-reflection, in general, diaries can both encourage (transformative) learning and help research participants explicate it. Semi-structured or unstructured diaries are of particular value, as Furness and Garrud (2010) suggest: 'unstructured diaries are often kept as a personal response to times of change, upheaval, and exploration, and also provide interesting information about routine and trivial life experiences' (p. 263). For those reasons and many more, diaries held a lot of promise as one of the main methods for this research project.

Because of the pandemic, however, it proved nearly impossible to find PhD students about to embark on a three- to six-month UKRI Policy Internship. In 2020, many students chose to delay their internships in the hope they could do them in person - which speaks to my earlier point on physical spaces and learning (see Chapter 3). After unsuccessful attempts at getting help from a gatekeeper of the UKRI internships, I identified a number of Doctoral Training Centres involved in environmental studies and contacted them to recruit interviewees and diary research participants. See Appendix G for the information sheet that I provided them for wider circulation. Apart from some positive responses for interviews, nothing came of it on the diary front. So, I then decided to get in touch with the host organisations, the list of which was freely available on the UKRI Policy Internship webpage and included the relevant contact information. I had more success with this approach, which surprised me. In fact, the civil servants I got in touch with were not only responsive but also quite receptive to the value of the diary research. In the end, by further stretching my data collection timeline (for the second time), I managed to secure three diary research participants. They all did their internships remotely.

An initial interview was scheduled with each participant. In that interview, I asked questions about their background and state of knowledge on science-policy (some of which I repeated in the exit interview to check for changes in opinion). The first interview was also an opportunity for me to explain the process and for the research participants to ask questions or raise concerns. I provided vague guidance on what they might write in the diary and with what frequency, emphasising the importance of 'frustrations' and 'surprises'. The diaries were therefore unstructured for the most part. Two of the three diaries were electronic (i.e. word documents) and one was physical. The physical diary was transcribed and returned to the research participant. Giving back is important in diary research, which demands a lot of effort and can be unpleasant for some research participants (Monrouxe, 2009). That was the case for one my participants who despised the exercise. Given the very small number, I decided to treat these diaries and the related interviews as an opportunity to experiment methodologically rather than expect usable data. To that end, my reflections on the promise and practice of diary research methods for studying adult learning can be found at the very end of thesis, in Chapter 8, and the data from diaries was not used in my empirical analysis.

4.4 Advisory committee simulation

The advisory committee simulation experiment was rather more serendipitous and opportunistic. I had been thinking about running some sort of workshop with early-career researchers, which I could design in a way that would generate some insightful data about learning. But it was when someone from the University's science-policy student society (Cambridge University Science Policy Exchange) approached me to ask if I was interested in running an event for them, that I started thinking seriously about how I might design an interactive workshop that could equally be part of my data collection. At the time, I was still observing Defra SAC meetings and thought that perhaps it would be a worthwhile exercise for postgraduate students to emulate a scientific advisory committee meeting. I also thought that some of the learning outcomes of such an exercise might mirror what I was hearing from experienced advisers.

Based on my ethnographic observations of Defra SAC, I designed a simulation which was carried out with PhD students (for the most part) at Cambridge, and in partnership with the student society. For the simulation, I asked potential participants to draft a short biography and to briefly lay out (in two to three lines) why they were interested in taking part. The reasons were two-fold: i) to weed out participants who might drop out and/or engage half-heartedly and ii) ensure multidisciplinary. I also paid attention to gender balance. In the end, we had eight participants and some observers. In the initial brief to the selected participants,

I did not provide a detailed agenda or any prereading material. This was deliberate so that they could not prepare and had to deal with the topic I had prepared for them on the spot.

They were told that the whole workshop would last about two hours, with the simulation lasting about an hour, and that I would be facilitating the whole time (see Appendix H for the invitation email and Table 3 for the workshop agenda). The workshop was planned to happen over Zoom. By signing up, candidates consented to it being recorded, as well as transcribed by a third party. Participants were also told that my simulation was based on observations of the Defra SAC. The additional detail that this was an evidence-informed simulation might have had a positive effect on the level of trust and credibility. The event was oversubscribed.

For the brief (see Appendix I), I chose to go with a topic that participants from different disciplines would feel competent enough to discuss and formulate an opinion on, while still being out of their comfort zones. It ended up being slightly more about policy for science than science for policy, but the benefit being that it brought out some territorialism around interests and disciplinary perspectives (see Chapter 8). The fictional story was that - as Chair of a fictional committee for the Government Office for Science (GO Science) - I had been asked to gather the members of my committee to discuss how best to distribute £2 billion per/year for R&D, focusing on the most pressing issues the UK will face by 2030 and on British industries with high expected returns on investment. To help with *immersion*³⁹, I wrote the brief in a way that I could read it out loud at the beginning of the simulation. The simulation ran in two parts: i) an exploratory horizon scan on the main science-related issues to be aware of up to 2030, and ii) a discussion on how to allocate the budget in rough percentages. The two parts were inspired by Stirling's (2008) idea of 'opening up' and 'closing down'.

³⁹ Immersion is a fundamental part of any roleplaying game or experience. It refers to the feeling of embodying a fictional character in a fictional reality. Participants can play themselves, but there needs to be a clean break with reality and a social contract that whatever is said during the game or simulation are the words of the puppet and not those of the puppet master. Simulation design needs to include strategies for immersion before and at the beginning of a session. See Mochizuki et al. (2021) for more information on best practice when it comes to *social simulations* on sustainability issues.

Table 3: Agenda for the CUSPE Advisory Committee Simulation

Activity	Time allocation
Introduction, housekeeping, and quick round of introductions	10 minutes
Briefing on exercise and opportunity to ask pressing questions (participants only)	10 minutes
Simulation exercise (Chaired by me)	1 hour
Debrief	20 minutes
Extended Q&A (priority to observers)	15 minutes
My closing thoughts and wrap-up	5 minutes

My chairing style was modelled after SAC's Chair at the time, especially around tight timekeeping, synthesising what members of my (fictional) committee said, and encouraging pragmatism (see Chapter 7). I tried to stay quite neutral and to avoid steering the conversation too much, but I did introduce a few pressures here and there. For instance, I reminded members of the committee that the task was a matter of political urgency, I said that our group (of scientists) had an interest in making good recommendations because the future funding of science depended on it, and I offered the occasional *worldbuilding*⁴⁰ element (e.g. saying that Brexit is high up on the political agenda and that we should take it into account). After the simulation, we had a twenty-minute debrief (see Table 3).

Debriefs are a fundamental part of serious game and policy simulation design (Crookall, 2010; Mochizuki et al., 2021). They offer the opportunity to leave the roles behind and connect the experiences within the simulation to the outside world and to one's own practices. Most of the learning happens in the debrief, rather than during play (Crookall, 2010). This was certainly the case for my pilot. The vast majority of interesting insights came from the structured discussion in the debrief. For the analysis of the transcript, I created my own coding framework - which largely emerged from the data. The results of the simulation are presented in Chapter 8. The next three chapters focus on the results from the empirical analysis of my interview and ethnographic data.

⁴⁰ The process of creating a fictional setting or universe, and everything that goes with it.

5 The two cultures?

It was an observation by a former CSA that triggered my thinking behind this chapter. With regards to the poor connections between scientific and policy communities, they said:

If you like, the two cultures, as in the C.P. Snow's 'two culture' kind of idea. If the two cultures sit apart from each other and just interact in a very structured, formalised way - either socially formalised or actually bureaucratically formalised - then you won't get that integration of common understanding about what the problems are and what the solutions might be between the two groups.

This got me thinking. Just how far could we stretch this metaphor? Can C.P. Snow's *Two Cultures* really be transposed onto science-policy? More importantly, what are the implications of viewing science and policy as two distinct cultures? What then would be the consequences for how we might conceptualise the learning experience of advisers? In this chapter, I tackle these questions and discuss the implications of a 'two cultures' metaphor for advisers' learning. In a first instance, I revisit C.P. Snow's lecture. I then explore the significance of interviewees' description of science and policy as 'worlds'. It follows that if they are indeed two different worlds, then their respective cultures are most likely distinct. I then go on to draw some boundaries between these cultures, sketching out what their main tenets might be. Despite their proximity to one another, I suggest that - at the policy end - 'policy culture' (i.e. civil service) ought to be separated from 'party political culture' (i.e. party politics). I go on to discuss both. For all three of these cultural groupings the usual disclaimers apply: all the cultural traits I describe should be treated as *ideal types* (i.e. a set of discernible characteristics shared by a given social group for analytical and comparative purposes), or *stereotypes* (see Section 5.3.1), and should therefore only be read as partial descriptions of trends in the real world.

It goes without saying that science and policy are obviously neither worlds nor cultures in a material sense, but I hope to demonstrate that conceptualising them as such unlocks many productive and unexplored lenses for studying what and how advisers learn. And if they are to be conceived as worlds in a more literal sense, they are to be understood as professional worlds - or professional cultures - which themselves contain various sub-cultures, including distinct institutional cultures. These cultures and sub-cultures are equally embedded in - and confounded by - the larger national political culture they are a part of (in this case 'British culture'). I elaborate further on institutional cultures in Chapter 7 and on national political cultures in Sections 5.4. Together, these different cultural clusters constitute and influence

the learning journey of science advisers. I argue that the fact that these clusters are all enmeshed does not necessarily invalidate the 'two cultures' thesis.

In the final sections of this chapter, I suggest that scientists advising policymakers experience *cultural encounters* in a similar way tourists or immigrants might. They learn to navigate the foreign culture through these (repeated) encounters and are routinely transformed by them. Drawing on vocabulary in sociology and anthropology, I devise a model of learning based on the idea of the two cultures, the cultural encounter, and the different cultural clusters mentioned above. It is worth noting that this model is likely to apply to any adult learner moving into a different professional field, but that remains an open research question. In the following section, I return to Snow's original thinking.

5.1 C.P. Snow and the two cultures thesis

When Lord Charles P. Snow stepped into Cambridge's Senate House, on 7th May 1959, little did he know that his staunch critique of a certain 'class' of intellectuals would go down in history as a defining moment in the delineation of science and the humanities. In fact, his lecture had little to do with the humanities as an academic constellation. His adversaries were what he called 'literary intellectuals', mostly 'writers and critics whose natural milieu was that of metropolitan publishing and journalism' (Collini in Snow, 2012, p. li), rather than academics *per se*. There is nevertheless no doubt that Snow's lecture was about mounting a defence of the natural and physical sciences, which he saw as a beacon of light for Britain's future. When Snow (2012) talked about a unified scientific culture, he was thinking about natural and physical scientists, both pure and applied (although he recognised their differences), who are mostly concerned with the study of natural systems. He later voiced regrets that he had not included a 'third culture', namely the social sciences (Lock, 2016; Snow, 2012).

In his lecture, Snow (2012) was mostly using the 'two cultures' as a device, or heuristic, to talk about some notable differences in practices and professional norms, and their respective contributions to society at large. For instance, he suggested that scientists and literary intellectuals have 'different kinds of mental activity' (p. 22). He recognised that the division into two is a slippery slope, and 'attempts to divide anything into two ought to be regarded with much suspicion', but maintained that it was a useful binary for his purposes, as more of a metaphor than a 'cultural map' (Snow, 2012, p. 9). He also recognised that the rift between the two cultures he described can vary in different national contexts - arguing that it might be far bigger in the UK than the US. This is an important acknowledgment of the intersection between scientific culture and national culture.

There are nevertheless signs that Snow (2012) was thinking of these two cultures as more than just useful abstractions. Indeed, he suggested that a scientific culture could also be devised in an anthropological sense: 'at one pole, the scientific culture really is a culture, not only in an intellectual but also in an anthropological sense. That is, its members need not, and of course often do not, always completely understand each other; biologists more often than not will have a pretty hazy idea of contemporary physics; but there are common attitudes, common standards and patterns of behaviour, common approaches and assumptions. This goes surprisingly wide and deep. It cuts across other mental patterns, such as those of religion or politics or class' (Snow, 2012, p. 9).

Mostly in agreement with Snow's line of thinking, Stefan Collini (2012) juxtaposes Snow's arguments with today's academic context, and argues that despite increasing specialisation within science (a trend that Snow had already noted), there are good reasons to think that a scientific culture that transcends disciplinary and epistemic differences exists. He argues that the subtle differences that grow with increasing specialisation are mostly invisible to those outside or on the margins of particular disciplines, let alone scientific research altogether. He writes that 'outsiders tend to see uniformity in other groups and fine distinctions within their own. From the perspective of a biochemist or electrical engineer the differences between an empirical sociologist and a modern social historian may seem barely perceptible; similarly, to the classicist or the art historian what the different branches of physics share seems far more salient than what divides them' (2012, p. lv). Collini's (2012) main point, I think, is to highlight that the very real and rich diversity of sub-cultures of knowledge production - as evidenced so clearly by Knorr Cetina's (1999) work on *epistemic cultures* - does not necessary preclude the existence of a wider academic culture. He is calling attention to a tendency amongst academics to see more difference than commonality. He writes: 'one of the hazards of academic life is the way its ethos and organisation encourages us to exaggerate the power and importance of these disciplinary affiliations to the neglect of other, often deeper, ties and allegiances' (2012, p. lvi).

There is no doubt that large disciplinary groupings continue to be the main way in which academic professional life and environments are organised. In that sense, they still play a fundamental role in creating cohesion between academics, in building a sense of shared identity, and in creating in-group/out-group dynamics (see Becher & Trowler, 2001). I even discuss some evidence that they might influence the ways in which advisers learn and their levels of reflexivity (see Chapter 6). But there are many aspects of the professional life of an academic that have little to do with disciplines. Academic work contracts are generally not

discipline-specific, nor do the various incentives and disincentives in the academic workplace vary wildly from one discipline to another. It is for those reasons that academic organisations like the Royal Society can claim to have a cohesive programme on 'Research Culture'⁴¹. It also explains why a critical mass of academics can relate to memes posted by Shit Academics Say (@academicssay on Facebook and Twitter), pretty much regardless of their disciplinary affiliation. They are funny and popular precisely because they resonate with the experience of a large number of academics across different national and cultural environments.

The contours of this larger community - or academic culture - are clearest when scientists engage with non-scientists. Collini (2012) articulates this brilliantly: 'there are numerous occasions when specialists, whether in natural science or anything else, have to put the case for their enterprise in language non-specialists can understand. This holds for activities as different as speaking at a university committee or reviewing a book in a national newspaper - or, to take an example close to Snow's heart, advising a government department on the use of a particular form of technology' (p. lviii). In their encounters with policymakers, scientists present and perform their cultures in distinct ways. Having only spoken to academics for this research project, my data is necessarily laden with stereotypical, outsider perspectives of the cultures of policymaking⁴². But equally, through their interactions with this foreign culture, academics have had to vulgarise and caricature their own. The reification of the two cultures debate in the 'science wars' illustrates this clearly: many of the arguments put forward by scientists afraid of the social constructivism of science studies 'relied on broad stereotypes, personal attacks and strawmen arguments to be effective', rather than accurate depictions of science (Lock, 2016, p. 163).

In reflecting about their experiences in the liminal space between these two cultures, my interviewees offered observations about the mismatches, communication breakdowns, and sometimes overlaps between their activities and worldviews and those of policymakers. At

⁴¹ The caption of the explanatory video of the project reads: '[research culture] encompasses the behaviours, values, expectations, attitudes and norms of our research communities. It influences researchers' career paths and determines the way that research is conducted and communicated' (see The Royal Society, 2018). Interestingly, the former CSA who mentioned the two cultures metaphor also said they thought learned societies - and the Royal society in particular - play an active role in reinforcing 'the two cultures problem', the 'them and us culture'.

⁴² Rebecca Willis' (2018) work takes the opposite approach. Although her work is about MPs' perspectives on climate change in general - and not only about climate science and scientists - there are quite few parallels in our conceptual approaches and research methodologies (see Willis, 2018, 2019). Through an analysis of personal narratives, Willis (2018) elucidates how MPs' approach to climate change is 'influenced by their understanding of the scientific evidence, but also by their professional identity, their conception of their role as a representative, and the way they navigate the day-to-day realities of life as an MP' (p. 486).

times, they even commented on becoming acutely aware through their encounters with policymakers of the ways in which they had been conditioned by their disciplinary training or their work environment. In the following section, I cast these encounters as a 'meeting of worlds'. Snow (2012) described the two cultures as 'two galaxies' far apart from each other. But whereas Snow's two cultures have no 'place' where they meet (Snow, 2012), the two cultures I am concerned with meet in many different places - sometimes in each other's galaxies and other times in a 'neutral' space. At times, they even dwell in the other's galaxy for a while - travelling back and forth. In that sense, scientists and policymakers can inhabit multiple worlds.

That was the case of Snow, himself. Not only did he have a PhD in Physics and was a science adviser in wartime, he was also a successful novelist and even later became 'the second-in-command at the newly established Ministry of Technology' under Prime Minister Harold Wilson (Collini in Snow, 2012, p. xxii). Snow (2012) spoke of his experience simultaneously inhabiting these different worlds as crossing 'an ocean', sometimes several times in a given day (p. 2). In the following section, I expand on this two-worlds hypothesis in greater detail.

5.2 The two-worlds hypothesis

I suppose I say scientist because generally - well, I'm stereotyping - but scientists would like to be a bit more wrapped up *in their own world*, in their own *research world* and not have to engage with the *wider policy world* on a day-to-day [basis]. I don't know if [it's] kind of odd if you say: "Oh, I'm a scientist but I'm interested in working in policy". *I think you'd have to adapt your sort of life and working habits to go from being a research scientist to working in the heart of policy*, as it were. You need to kind of *change your whole mindset* and to, I guess, see yourself less as a kind of scientist locked in an ivory tower. It's very different from normal science work in many regards (former intern, emphasis mine).

One might think that using 'worlds' to describe academia or policymaking is a linguistic quirk or quite a reductive way to describe what is ultimately a heterogeneous group of people and institutions based in multiple geographic locations. The former was certainly the case for some of my interviewees, for example this former intern talking about career choices:

I was always uncertain about whether I would want to do a PhD or whether I'd just like to get straight into the *world of policymaking* and particularly in UK climate policy (emphasis mine).

But in this section, I want to argue that there is often a much deeper meaning in ascribing a world status to either academic research or the business of governing. For instance, when both worlds are pitted against one another, it is often revealing of the distance or difference between them, with their inhabitants effectively seeing each other as 'extra-terrestrials'. With

regards to the implications of growing up and living in one world and not the other, consider the following quote from a former CSA:

Scientists will always talk about uncertainty because you know we'll never see anything as a fact, really. There is always, you know: "a very high degree of certainty here". It's a language we are very comfortable with and I suppose it's hard for politicians *if they don't live in that world* to be able to understand: "what does that really mean? Does it mean I have to do something about it? Or does it mean there is still enough uncertainty that I should wait until we are more certain?" (emphasis mine).

Or this one from an experienced adviser, with a lot of humour, on the ideals of science:

If you *spent your life as an academic in an ivory tower*, you make progress by persuasive arguments, don't you? You *spent your [work] life debating*. And science is: something is true in science until it's not <h>. And that's *the way you are taught to think*. I mean of course, [not] all scientists change their mind <h>. They tend to hang on to views but, actually, suddenly you get the kaleidoscope moment; the picture changes, you think: "bloody hell. I was wrong", you know. [Working with policymakers] is not that - and although you've got all the things about egos and ambition and everything in science - *the politics of policymaking is just a whole different world. A whole different world, and nonetheless [an] interesting [one]* (emphasis mine).

In both cases, the interviewees are suggesting that politicians or policymakers basically 'live on another planet'. Amongst my research participants, this sense of difference or even estrangement came up in different guises, albeit not always with a direct allusion to 'worlds'. But if we take this 'two-planet theory' seriously for a moment, we can infer that in order to communicate with each other and build relationships, inhabitants from one world might have to occasionally physically move to the other world.

In the context of the UK, this physical movement is often very one-sided - with academics travelling to the Houses of Parliament for select committee meetings, to a government building where a scientific advisory committee's secretariat is based, or indeed to Whitehall in the case of CSAs and UKRI interns⁴³. As one experienced adviser put it: 'it's almost impossible to get a civil servant out of their office into a meeting unless you live essentially within 500 yards of Whitehall'. As with any travelling, inhabitants of one world visiting the other might also need to learn the local language and read up on their customs. And here the onus is also arguably often on academics (see C. Boswell & Smith, 2017). As one experienced adviser suggested, a significant investment of 'time' and 'homework' is needed:

⁴³ There are exceptions of course. CSaP's Policy Fellowship scheme is a good example of policymakers travelling to meet academics. Moreover, Whitehall civil servants do not often travel to sites in general, unless to accompany a Minister. More often than not, they opt for the phone instead.

I am willing to invest a portion of my time to understand *their world*, so that they can access *my world* more efficiently (emphasis mine).

If you do a little bit of homework... you might pitch more interesting information, but [you've] fairly quickly got to demonstrate that you're listening to your audience, that you're *learning about a world that isn't yours*. Whether you're a car designer or a virus specialist, you've got to understand what your audience is after (emphasis mine).

In terms of initiating contact and engagement, academics generally have to get the ball rolling, and often do so on policymakers' terms. For this experienced adviser, the 'polite way' of engaging with policymakers is to get invited 'into their world', by giving a talk at a conference for example. Moreover, if impact is the endgame, the forms of engagement initiated and preferred by the academic community often fail to produce results. Some of the experienced advisers strongly emphasised that the linear model of science-policy - which many academics default to - is at best ineffective. As a former CSA explained:

The trouble is [with] *the type of interaction that the science community has often preferred*. It's often preferred to get on with its own work, in its [own] way, *in its own world*, and when something comes up that it thinks that the policy community should be interested in, then *it essentially packages it up and lobs it over the fence* (emphasis mine).

The reasons for defaulting to this form of interaction are not laziness or lack of interest. Instead, the linear model closely replicates the most important reward system in academia: publishing. It is no surprise then, that impact in science advice might be wrongly construed as working similarly to impact in academia, namely through the production of papers and the subsequent attention they get. If academics spend too much time in a world that centres around publishing, they might assume that is also the case for other worlds. As one former intern said: '[you] can kind of get lost in this academic world and write papers and forget why you're doing it'. To remedy that, they recommended that early-career researchers do policy placements 'to remind themselves of the bigger picture and just to see how it actually works in practice, and remember that your paper is just going to end up in a journal filed away and your grain of sand is going to mean nothing'.

Coming to this conclusion was a process of transformative learning for them. They had started the internship 'looking for something that [they] could write down' and later recognised that they had been conditioned by the academic environment to do so. This common transposition or cultural projection is akin to anthropomorphising aliens or perhaps even, at times, a form

of *ethnocentrism*⁴⁴. Through sustained engagement, academics come to better understand or accept the differences between their world and the foreign world they have stepped into.

Although the world of civil servants is often full of surprises for academics, it was actually less alienating for some of my interviewees than the world of politicians. This is what two experienced advisers said in that regard:

And the trick is to know *which world you're in*. I mean if you think you're still in the *policy world* and *actually you've gone into politics*, you're going to get [...]... I mean I'm a bit political but *I'm happier in the policy world*, that's my instinct... I know *I'm happier in that [world]* (emphasis mine).

I'm going: "you do understand that I'm an academic and this is data, don't you?" And they go: "yeah, *but it can't be true because it doesn't match my world model*". And I've had this discussion with senior politicians (emphasis mine).

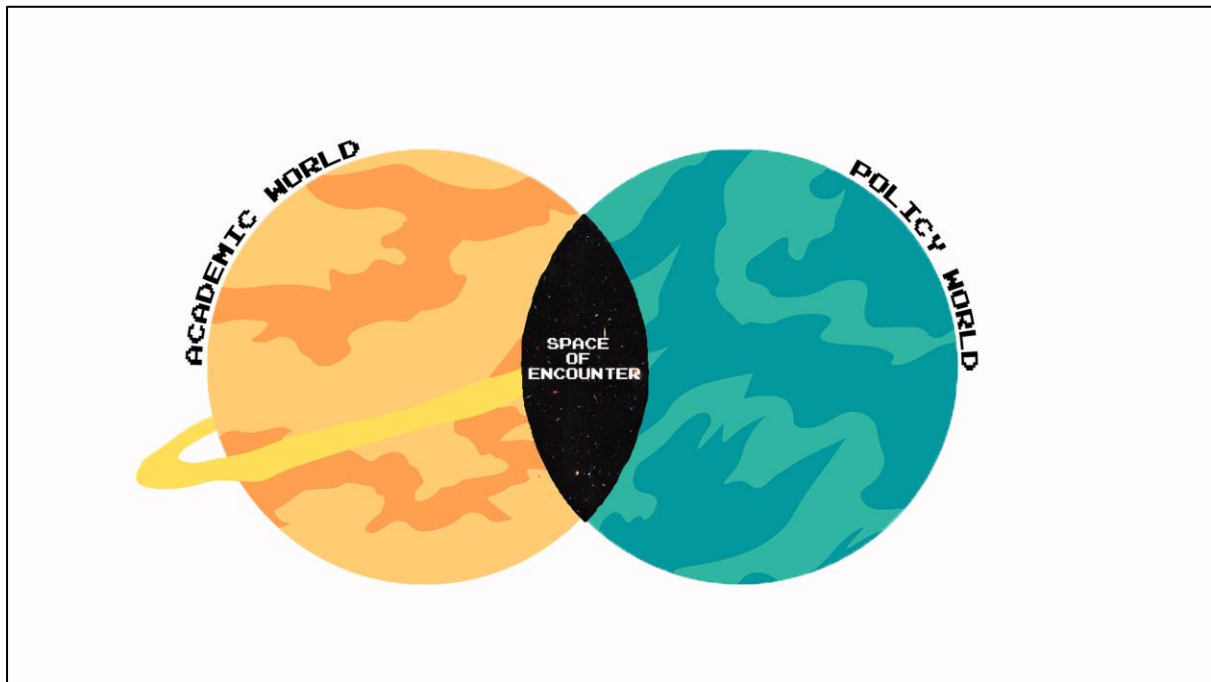
Another experienced adviser suggested that science advisers operate in a 'no man's land between the world of science and evidence, and the world of politics on the other hand, and you're trying to inform policymaking as an in-between; it's the bridge'. Here, we see a rather common hesitancy shared in the world of academia, but also perhaps biased by the sample of interviewees. Although it is undeniable that policy and politics are intimately intertwined, my interviewees and many other science advisers have stated that they are more comfortable in the policy world, steering away from politics which they often see as devoid of the ideals that govern science. I would go as far as saying that this kind of boundary work between science and politics is so common that there must be something about the perception of the culture of politics, within the science world, that is deeply incompatible with the value system of its inhabitants. But more on that later (see Section 5.3.3).

For the time being, we will content ourselves with two worlds - which may either collide or collude – and, as such, can be visualised as a simple Venn diagram (see Figure 6, below). At the intersection of both worlds is what I call the *space of encounter*. This can be a designated space within or on the periphery of one of the worlds (e.g. advisory committees or science

⁴⁴ 'Ethnocentrism is a term applied to the cultural or ethnic bias - whether conscious or unconscious - in which an individual views the world from the perspective of his or her own group, establishing the in-group as archetypal and rating all other groups with reference to this ideal. This form of tunnel vision often results in: i) an inability to adequately understand cultures that are different from one's own and ii) value judgments that preference the in-group and assert its inherent superiority, thus linking the concept of ethnocentrism to multiple forms of chauvinism and prejudice' (Baylor, 2012, p. 1).

advice offices in government departments), or a neutral space (e.g. boundary organisations). It is within such spaces that exchanges, collaboration or conflict, and learning occur⁴⁵.

Figure 6: The two worlds and the space of encounter as a Venn diagram



One of the major takeaways of the two-worlds hypothesis, is the importance of *dwelling* in either world or in the spaces of encounter. Dwelling is absolutely essential for advisers' situated learning. By temporarily setting up camp in a space on the periphery of the policy world or within it, academics learn about the ways of life of that world. The very goal of policy fellowships, for example, is to facilitate this kind of dwelling and hence maximise learning (see Chapter 8 for more on that point). Whilst these various spatial metaphors go some way to account for the relationship between science advisers and policymakers, I will argue that there are many more advantages in conceptualising each world as a culture and ergo their contacts as *cultural encounters*. I expand on the idea of the cultural encounter throughout the remainder of this chapter. I first tease out some of the traits of each culture mentioned by my interviewees and based on my personal observations, below.

5.3 Science, policy, and party politics

As I discussed above, in relation to worlds, there are good reasons for dividing the policy side into two cultures. This division is mostly a product of the data from interviewees, who often distinguished their experiences with civil servants from those with politicians or party-political

⁴⁵ These are not always necessarily material spaces. Not just because of the increasing digitalisation of meetings, but also because encounters can happen in spaces that are not specifically designed for exchanges between scientists and policymakers (e.g. conferences).

environments (e.g. parliamentary select committees). I focus mostly on what I am calling 'science culture' and 'policy culture', but will also briefly touch on the idea of a 'party political culture'.

5.3.1 Ideal types and stereotypes

In talking about these different cultures, interviewees offered numerous stereotypes and caricatures of scientists, civil servants, and politicians, many of them humorous. Stereotypes are generally understood as 'widely held societal beliefs and expectations about individuals who share a set of common physical and/or sociocultural characteristics or group memberships, such as: ethnicity, race, gender, social class, or nationality' (L. O. Rogers et al., 2020, p. 63). They are usually seen in a negative light: as cognitive biases and limitations, outright prejudice, simplified mental models to make sense of complexity, and/or as overgeneralisations (Hinton, 2013, 2017; Quadflieg & Macrae, 2011; L. O. Rogers et al., 2020). Yet, they should not be overlooked because their cultural significance is abundantly clear. Firstly, they play an important role in the construction of group (and hence cultural) identity (L. O. Rogers et al., 2020). Secondly, they play an important role in intercultural communication and learning. As Hinton (2013) points out, 'in many of our everyday encounters with people we learn very little about them, but what we do learn is often information that can be used to categorise them' (p. 5).

He highlights that insofar as stereotypes are about 'judging people as category members rather than individuals', they should be treated as a form of 'cultural knowledge' - however accurate they might turn out to be (Hinton, 2013, p. 5, 2017). Stereotypes are 'an element of cultural heritage that is passed on from one generation to the next' (Quadflieg & Macrae, 2011, p. 218). Thirdly, stereotypes play an important role in policing and predicting behaviour; they serve as heuristics in making determinations about what is and is not appropriate in a given cultural context. In Hinton's words, 'the wide range of semantic associations [or stereotypes] we learn in our culture can successfully guide our judgements from what to wear at a job interview, which side of the road to drive on, and how to talk to the boss' (Hinton, 2017, p. 5). Taken altogether, stereotypes are - as Hinton (2017) suggests - 'culture in mind': a stored and readily accessible partial picture of the culture one inhabits.

In the context of intercultural exchange, stereotypes constitute part of the tacit knowledge that individuals from one culture learn and assimilate in their encounters with a foreign culture. Stereotypes can therefore be understood as mental shortcuts used by my interviewees to summon, process, and communicate their intercultural experiences in science-policy. The (perceived) stereotypes they mention are helpful and revealing on multiple levels. When they

are directed inwards - i.e. towards the science culture - they are revealing of how scientists like to think of themselves (ideals) or what they find disheartening amongst peers. When they are directed outwards, they are revealing of the aspects of policy culture that interviewees have come to accept and those that they still struggle with. Stereotyping can also reveal the level of exposure interviewees have had to the foreign culture and/or the level of critical reflection (depending on how naïve their stereotypes are, for example), both of which affect their learning.

From the point of view of data analysis, as ideal types, they offer the best source of knowledge for: i) delineating and determining the principal characteristics of the three cultures; ii) accessing tacit learning around prevailing norms and behaviours within them; and iii) understanding why and in what instances 'culture shocks' might occur (see Section 5.5). In the context of my research design, there is however an important limitation that comes with relying on the stereotypes offered by academics on cultures other than their own: there is sound evidence that humans tend to see more homogeneity in the out-group than in the in-group (Quadflieg & Macrae, 2011). It is also worth noting that the stereotypes and/or ideal types presented in the following sections are just a curated selection of the total pool in the data. They have been grouped into three main categories: i) characters and traits, ii) attitudes, and iii) workplace norms.

5.3.2 Characters and traits

Many of my interviewees mentioned what they saw as distinctive traits shared by scientists and civil servants, respectively. Starting with the scientists, one experienced adviser said to me that most 'good scientists' are INTJ (Introverted, Intuitive, Thinking, and Judging) in the Myers-Briggs nomenclature. Another claimed that scientists 'love complexity', whilst yet another suggested that 'scientists are probably more tolerant than most people, they are more objective'. Scientists ideally distrust their instincts, question their 'first unconscious/emotional reaction', and 'try to take a more overarching approach', according to one experienced adviser. One other typical characteristic of the scientist that appeared in different guises was their fixation on details and precision, with one experienced adviser expressing frustration with the criticisms they would receive from colleagues on their advice to policymakers not being '100% watertight'. Interviewees also pointed out that scientists can be quite set in their mental models, as illustrated by this former CSA's account:

I used to get fed up. I would invite scientists, academics, to come in and speak to policy colleagues, and the academics - even though I'd told them: "just present your results" - they would come in and they'd start: "background", "materials" and "methods". And then policy

colleagues weren't interested. They just wanted the results. And so, having that whole training for scientists was part of it.

Several interviewees also spoke of the arrogance that certain scientists emanate, sometimes with a dismissive attitude towards non-experts. For example, a former CSA spoke of how they would learn how to pronounce the name of compounds before meeting with colleagues in chemistry or biomedical sciences, so as to not lose face and in order to harbour respect.

Civil servants were described as 'lawyers' by one former CSA, insofar as they argue their case without their integrity depending on it being taken up by a Minister or not. Civil servants were also seen as experts in impartiality, especially by those interns who worked in parliamentary organisations. One of them said that they were amazed to discover that parliamentary staff are '100% absolutely impartial', and much more so than many of their scientific colleagues. It was through their internship they had 'really become aware of just how your own implicit biases can colour your writing'. The writing style of civil servants was a source of transformative learning for another former intern who spoke of initially being quite 'wordy' and - through the internship - they 'changed [their] perspective' on their approach to writing thesis, i.e. making the 'PhD as short as possible' and as clear and concise as possible.

Several former interns were impressed with the dedication and work ethic of civil servants. One of them who interned during the most politically volatile times of Brexit negotiations told me: 'I just didn't know how they stayed motivated. I was so impressed <h>'. A few interviewees (across levels of experience) mentioned how they had been surprised not just by the commitment of civil servants, but also by their dedication to enact positive change. A former intern recounted that through their internship they came to realise that:

It was much more forward thinking and people were really trying to make a difference more than I had thought; it wasn't that they didn't want to make difference, it's [just] not possible in a lot of scenarios. And just the like calibre of people working there. I was just really impressed and everyone had like such a strong work ethic and commitment to what they were doing, which surprised me. Not that I didn't think they would, but just the consistency of that. I can't think of anyone I came across that sort of wasn't working kind of crazy extra hours and really passionate about their area, and trying to make a positive change.

Finally, and perhaps most importantly, civil servants were described as inherently suspicious and cautious; they take confidentiality very seriously. For example, one experienced adviser suggested that if you 'network like hell', you might trigger suspicion in the civil servant. This chimed with their idea that it is always preferable to get invited into their world rather than

impose your own. I will talk more about confidentiality and caution in Section 5.3.4 on workplace norms.

5.3.3 Attitudes

Scientists vis-à-vis policy and politics

Interviewees spoke of some general attitudes exhibited by scientists with regards to politics and policymaking. According to a former CSA, the fact that 'the most important questions to humanity sit within government' is generally 'not really appreciated by the academic community'. A number of interviewees also lamented the disregard some academics can have for applications of science outside of science and/or making their research societally relevant:

One researcher who was on a Research Council once came to me and said: "Well, actually, the Research Council I'm on has decided that our priority is to research things that nobody else is interested in" (experienced adviser).

I think some academics don't really care if they influence policy or not. You know, as long as they're in the top journals, being regularly cited, that's their goal (experienced adviser).

Overall, interviewees hinted at widespread cynicism within the scientific community towards politics, with one experienced adviser suggesting that scientists also often deny the existence of politics and power within science. Several interviewees expressed their discomfort with being involved in things that got too 'hot'. One experienced adviser claimed that 'most scientists try not to get into things that are too controversial'. Another told me that they found parliamentary select committees to be 'really fun', except for those that 'get political'. For a former intern, it was challenging to be a scientist in the highly political environment of Parliament: it was 'tiring always being in the centre of a kind of political establishment, because you just can't get away from the politics <h>'. Further evidence for the ubiquity of negative attitudes towards politics - which is often floated - is the staggering lack of scientists and/or individuals with scientific backgrounds running for office. As of January 2020, the proportion of UK MPs with STEM backgrounds stood at a meagre 16%, according to the publication *Research Professional* (Inge, 2020). And the consequences for evidence-informed policymaking are dire, as one experienced adviser put it:

If the people who care about evidence say politics is messy [and] therefore don't show up, you can't be that surprised that the people who show up are the people who aren't interested in evidence because those who care just excluded themselves.

One by-product of these widespread attitudes is that many scientists would more readily compare themselves with civil servants - who they tend to see as the least morally and

methodologically deficient group in the political tribe - than with politicians. Yet a significant number of experienced advisers and former interns told me they had been surprised or astonished when confronted with how civil servants 'really are'. And indeed, discovering that the presumed resemblance between civil servants and academics is largely founded in wishful thinking can be a source of transformative learning, as this former CSA testifies:

When I went to be a Chief Scientific Adviser, I had thought: "well, these smart civil servants have done very well academically, they write considered papers, and they are bit like academics, maybe". And so, the Chief Scientific Advisers will be close to the civil servants in culture and in attitude. And the politicians are kind of fly-by-night characters... On the spectrum between politicians and civil servants, the Chief Scientific Advisers will be closer to the civil servants. [Well], that's completely false. They're not. They're [really] not. No. Chief Scientific Advisers, generally, are much closer to the politicians in certain cultural and personal attributes. So, as an example: civil servants will never want to write their name on a paper they write.

These sorts of surprises are important because they are further evidence that there is a prevailing perception amongst scientists of the world of policy as being more (culturally) proximate to, and compatible with, the world of science than the world of politics. A few interviewees also expressed surprise at finding out that civil servants cared about evidence and that a number of them had PhDs. For example, one former intern said that their 'perspective did change' when they found that Natural England's work was quite 'academically-informed'. Another former intern shared that witnessing that 'a lot of policy is supported by rigorous science - and certainly systematic, logical processes - was very reassuring'. Yet another told of their surprise that:

Even some of the more senior members of staff were interested in talking to me about some of the stuff that I was doing and the knowledge that I had about stuff. And that they were also using academics and academic papers to inform the work that they were doing. In that respect, it was really nice to see that these are qualified scientists working in a government institution and using science to inform their work.

There are other beliefs about policy and politics that scientists harbour before being confronted with the reality on the ground. I have already mentioned the linear model as a transposition of scientific cultural preferences onto policy. This unconscious bias is widely discussed in the literature (e.g. Owens, 2015) and increasingly acknowledged by science advisers. But perhaps less discussed among scientific circles is the unhelpful fear that honesty about the limitations of science will lead to the erosion of its epistemic authority or 'exceptionalism', as one experienced adviser put it. They added that 'the idea that there is a thing called the truth with a capital T and that we, scientists, have it, and you idiot politicians

don't have it, is just an incredibly unhelpful narrative', and changing that narrative would require a 'big culture change'.

Finally, as both experienced and less experienced advisers pointed out, scientists can display unawareness and/or voluntary ignorance when it comes to the kinds of constraints and pressures policymakers are under. The most common cultural mismatch (on both sides) mentioned by interviewees was the perception of time and timelines scientists and policymakers operate under. This was certainly the opinion of a former intern who suggested that many academics do not appreciate the extent of the time constraints placed on policymakers, and that they should not expect the same amount of due diligence as in science.

Moreover, an experienced adviser expressed to me that academics who criticise government decisions from the outside have it easy; they do not have to make the difficult decisions and therefore also bear the responsibility. They gave the example of Independent SAGE⁴⁶: 'there's no risk for Independent SAGE saying: "oh, shit, you did what we said and actually it caused unforeseen problems"'. They offered the metaphor of cricket to illustrate this 'asymmetry', whereby the bowler 'has it much easier' whereas for the batsman 'one mistake is fatal'. Roger Pielke Jr. and colleagues coined the term *shadow science advice* to describe these groups of scientists who claim to be providing policy advice while being outside of the formal and/or established mechanisms of science advice to the government (see EScAPE, 2020).

Policymakers vis-à-vis science

The following accounts are necessarily second-hand as they originate from scientists speaking about how they perceive civil servants' attitudes towards science. Unlike the attitudes laid out above, they are products of (situated) learning from their encounters with policymakers and/or from working within government, and therefore not from individuals socialised and ordinarily working in policy environments. In a nutshell, they are perceptions of pro- and anti-science behaviours. I have already touched on some of these perceived attitudes, for instance that there is a great deal more respect among policymakers for science and evidence than many scientists and especially early-career researchers expect there to be. The misalignment between expectations and realities on the ground can oftentimes be disorienting for less experienced science advisers.

⁴⁶ Indie SAGE, as it is known, was an ad hoc group of scientists set up and initially chaired by Sir David King with the remit of providing 'independent' advice to the UK government on matters related to COVID-19. Indie SAGE was explicitly positioned as an alternative to SAGE (Scientific Advisory Group for Emergencies), the flexible advisory mechanism/committee set up by former GCSA Sir John Beddington to offer advice on emergencies (e.g. the eruptions of the Icelandic volcano Eyjafjallajökull in 2010).

For instance, the kind of privileged place that some scientists think science ought to have in political decision-making does not always - and frankly seldomly - exists in policy circles. A former intern discovered through their internship that the 'weight of opinions... [was] made equal between people with policy interests and interest groups, ...and people with academic research experience'. In many cases, it was unclear to my interviewees how civil servants made their judgements; in particular, how they weigh various interests and pieces of information. One experienced adviser admitted: 'I can see them being made but I don't know how they're being made, because I'm not in their position'. Civil servants were, however, generally praised as quite respectful of scientific inputs and methods. Most former interns said they never had to compromise their scientific integrity, despite one of them admitting that they could see how they would have had to compromise their scientific integrity if they had stayed longer or ended up pursuing a career in the Civil Service.

Moreover, a few interviewees spoke of some instances of 'unscientific' behaviours with regards to handling evidence. In one case, a former intern recounted how policy colleagues got excited about the talk of an academic whose core ideas had been debunked in the academic literature. Rather than doing proper due diligence, they ran with it and took the academic's words as the state-of-the-art evidence on the matter. In the eyes of this former intern, this was a case of being attracted to the branding power rather than the veracity of the idea. So, they decided to intervene and make colleagues aware of the ongoing academic debates and, to their surprise, the policy colleagues were mostly grateful and open-minded about their intervention. The underlying point here is that civil servants are not culturally primed to approach scientific evidence with the same degree of scepticism than a scientist would. Echoing that point from a different angle, one experienced adviser asserted that many civil servants trust academics to be honest about the relevance or limit of their expertise regarding a task at hand, even though that is not necessarily the case. What the data does not tell us is whether or not the above behaviours stem from uncritical deference to scientific expertise or from a susceptibility to availability and confirmation bias in policy circles (i.e. evidence that fits the dominant narratives and/or desired policy outcomes).

Some former interns also complained about the lack of freedom of inquiry and original thinking within government. This was one of the main causes of discontent for the sole former intern who had a chiefly negative experience in their internship and who said there was a clear 'mismatch in culture'. They felt that all scientific inputs remained at the level of rigid literature review and synthesis work and that scientists' talents were largely underexploited. For another former intern, while the lack of flexibility in producing their evidence statement - with regards

to search terms for example - ensured rigour in the process, they also thought that the process could benefit from a bit more bottom-up agency. A more serious accusation came from an experienced adviser who claimed that there is too much confusion on types of evidence in political environments, especially in parliamentary select committees. They mentioned a common failure amongst parliamentarians to distinguish 'between evidence in a scientific sense and evidence in a legal sense'; they almost get used interchangeably.

Attitudes towards social science

I want to briefly turn to attitudes towards social science, because a large amount of social science occupies a different place than STEM subjects both within the minds of fellow natural and physical scientists, on the one hand, and policymakers on the other hand. In the scientific community it is seen as mostly a policy- or societally-relevant research endeavour and there is still a culture of dismissiveness towards social science among natural and physical scientists. In the policy community, social scientific research continues to be used instrumentally (see Kattirtzi, 2016), mostly to help with the implementation and enforcing - rather than design - of policies. Social science is often not afforded the same degree of epistemic authority than STEM subjects⁴⁷ and/or social scientific evidence is not considered to be on par with scientific evidence (especially qualitative research). Hence, the learning experiences of social scientists or scholars in the humanities - as advisers - might differ quite significantly from those of colleagues in STEM disciplines.

One challenge that social scientists on committees might face is the extent to which fellow scientists, and especially CSAs, are receptive to the value of qualitative social science. It was through their engagements in science advisory settings that one of the former CSAs (a physical scientist) I interviewed learned to 'appreciate the importance of all parts of science', including social science, the humanities, and indigenous and local knowledge. Another experienced adviser, a social scientist, told me that there is often an interdisciplinary prejudice wherein social scientists are seen as troublemakers, making things more complicated. They admitted that social scientists can be a bit of a 'broken record' and that their line of attack or defence is pretty much always: 'it's a bit more complicated than that; you've forgotten about class, gender, power, etc. <h>'. They learned on the job that:

You have to really bite your lip and, [then] you tend to go in and start articulating issues a little bit more like scientists do. And then just adding things. So, I think a really useful way of operating is to kind of think carefully about how the scientists or modellers are talking, and then see if you

⁴⁷ Some experienced advisers suggested that economics might be the exception to that rule.

can sort of add a little bit of nuance or make sure that the social is in there... You can't just go and say: "Oh you've forgotten about this, this, and this. It's more complicated than that". You actually just start to lever in elements that work within their frames of explanation. And I think that really helps everybody, actually, because none of these people are stupid <h>. Some social scientists go into these meetings and think that nobody understands apart from me. That clearly isn't the case. You've actually got to format the way you speak and the way you work to try and figure out where are the kind of areas that we can kind of add in something about the world that I know about more than they do and that they know, and they can start to have creative and useful effects.

As this experienced adviser suggests, social scientists have to choose their battles and be mindful of how they frame their contributions. They added that social scientists are used to this because it also part of the culture in social science to change the way problems are framed within academia.

Finally, there are some prevalent perceptions within both the social scientific community and the policy community respectively that stall deeper engagement between them. For one experienced adviser, there is a clash between the critical social sciences and the culture of Whitehall, because the social scientists are trained to see and expose the vested interests and the 'small p politics' in every institution. And because some vested interests remain unspoken within the Civil Service, there is 'clearly a mismatch between the critical, sceptical approaches of probably all science, but in particular social sciences'. This clash can play into the troublemaker narrative described above. But equally there is some reluctance on the part of social scientists to engage in advisory work because they fear being used instrumentally to legitimise and help implement existing policy decisions, such as improving messaging or nudging, and/or advise on compliance. To quote one experienced adviser, 'there's a lot of social scientists like me, but normally they don't get anywhere near these committees'. Another joked about the FSA assembling 'a group of social scientists to tell people how to cook their chicken better, so they didn't get food poisoning <h>'.

Although many social scientists are concerned about what Kattirtzi (2016) calls the 'instrumental rationales' for drawing on social science, his research on social researchers within government concludes that the belief amongst academics that the Civil Service is completely unreceptive to criticism is largely unfounded and that, in the right circumstances, government analysts can fulfil a 'challenge function'.

5.3.4 Workplace norms

So far, I have discussed some of the perceived characters and traits of UK-based scientists and policymakers, as well as their attitudes towards each other. However, a crucial part of the cultural puzzle is missing, namely a discussion of the sociomaterial and institutional environments within which they are socialised into the aforementioned behaviours, values, professional norms, and so on. In particular, the influence of organisational culture in shaping situated learning and transformative learning is highly significant, and is addressed in greater depth in Chapter 7. For now, I will focus - in much broader terms - on some of the general workplace norms that my interviewees observed and/or experienced in their own academic environments, as well as in the various policy and political environments they had been exposed to. I will be highlighting which of these norms and practices seem to greatly diverge between both worlds, as well as those they appear to have in common.

Academic environments

For a few of my interviewees, reductionism and narrow expertise continue to be the dominant paradigms in most academic institutions - which contrasts sharply with the kind of generalism that is commonplace in the Civil Service and in other political environments. In fact, some interviewees deplored the pervasiveness of disincentives around interdisciplinarity in science, with one of them saying that 'the way to succeed is to be very, very narrow and deep... I don't think [that] is ideal'. Another spoke of the 'double jeopardy' of interdisciplinarity, where one needs to be excellent both in their narrow field of research and at putting disciplines together (which are two very different skillsets). As studies on inter- and trans-disciplinarity have demonstrated (e.g. Freeth & Caniglia, 2019), this emphasis on narrow subject matter expertise means that academics are often ill-equipped for collaborating across disciplines, and thus exposure to other disciplines can and will often be a learning experience. For example, consider the following experienced adviser's account of transformative learning through collaborations with social scientists:

I mean you still have to be an expert in your own -ology to get anywhere in science, but I think that doesn't preclude you from understanding the perspectives of other areas of science - which I didn't do earlier in my career... I was [just] interested [in my narrow area of science], and it was before I'd seen the important impact of the societal interpretation of things and worked a lot more with social scientists in more multidisciplinary studies. So, I think what I would say to [my] younger self is: "get involved in more multidisciplinary stuff early on, with social scientists".

While some of my interviewees were already working across disciplines early on in their academic careers, others were exposed to interdisciplinarity through their policy-facing and/or

science advice work, such as sitting on multidisciplinary advisory committees. In the end most, if not all, of the experienced advisers I interviewed ended up having highly interdisciplinary career paths. In Chapter 6, I discuss why this is unlikely to be a coincidence but rather a feature of the skilful adviser's journey. A handful of them suggested that the culture of ultra-specialisation and siloed disciplines does not only pose serious challenges for the exercise of science within purely academic environments, but equally has important repercussions on the ways scientists relate to worlds outside their own.

The most damaging consequences for the science-policy relationship are the resulting disincentives around pursuing non-academic work or career paths, and the lack of experience discussing matters beyond one's own research area. On the former, several experienced advisers were actively discouraged from pursuing non-academic roles. One told me that their colleagues had warned them that nothing good would come from leaving their narrow research area to pursue 'big picture stuff', and that they had 'proved them wrong' in the end. In a similar vein, a former CSA received negative comments from colleagues for choosing to work in a science management role. The most striking account came from an experienced adviser who said:

People don't see you as a great academic if you have interactions with policymakers. It's better to interact with policymakers than with the public. So, if you do public work, like I do, you know media work, that's "terrible", that's the bottom of the queue. At least policymaker work is kind of a bit more sort of "respected". But it certainly doesn't make you look like a better scientist... So, all this to say: there are these incentives, [but] there's not a massive amount of incentives.

Encouragingly, though, another experienced adviser suggested that the culture around policy work has changed compared to when they started, although there is still much work to be done:

I think that on the good side it is far more accepted that part of the job of being an academic is to engage in the policy world. I think there is more tolerance and respect for people who do that. And it's no problem if you're an old fart like me <h>, but I think there's more tolerance and respect of younger career people who do it. I think that, in trying to emphasise the importance of impact and the importance of all the work we do, then we have some of the incentives wrong. So, there's now a pressure on everyone who produces a paper - or at least a paper in a higher impact journal - to write a rather self-congratulatory press release saying how important it is. And I think that can be unhelpful and - dishonest is the wrong word - unhelpful is the right word. So, I think there needs to be a little bit more realism about what makes good policy advice. And good policy advice is not writing a press release about your latest study, but is perhaps summarising a large body of work in a way that can be understood by policymakers relatively

easily. And we may not have got our incentives [right]. I think some of our incentives are going in the right direction, but [others are] a little naive and not producing maximally beneficial outcomes.

Relatedly, in discussing the culture within academic institutions, interviewees also brought up the issue of (appropriate) skills and professional development. With regards to norms around deep specialisation, one experienced adviser admitted that they continue to be surprised by how much 'real systems experts' struggle to 'apply [their] skills in a wider context'. They mostly attributed these difficulties to:

The way academia works at the moment; it encourages people to invest their identity in the fact that they're, I don't know, a chemist with an expertise in catalysis or something <h>. And so their kind of currency for interacting with policy is: "I can tell you about catalysis in chemistry" rather than "I can think about problems in this analytical way". It's part of the problem - in my view - that the academic system is currently very heavily invested in subject-based expertise. And that's what the reward structure looks like. That's what's going to get you promoted and all of those things... If science was less of an identity - a separate weird identity - and more of a skillset and a way of thinking that anybody could use, then I think things would be better <h>... [At the moment] academia absolutely is driven by this idea that you develop your domain-specific expertise and that is somehow part of your identity, part of your kind of "badge of honour" and, yeah, commenting outside that is "uuurgh" [sound of shiver/disgust].

Largely in agreement, one experienced adviser argued that universities focused too much on 'cognitive ability' and that there was still not enough training on 'vocational skills' and 'emotional skills for communication', and that 'we need to make sure that we've got those in balance'. They added that it is 'not just the diversity in terms of disciplines [that matters], it's [also] the diversity in skills'. And there is evidence that academics are already having to come to terms with skillsets typically associated with other professional spheres. For example, one experienced adviser observed that more and more scientists have to learn to be managers on big projects or of large labs. The discussion on skills is picked up in Chapter 6.

Taken altogether, the combination of a culture of narrow expertise and limited engagement with non-specialists (outside of one's area of expertise or non-academic audiences) affects the preparedness of academics in their encounters with policymakers and policy issues. That was the line of reasoning taken by an experienced adviser who claimed that the reductionist ideal and tendencies in the culture of science were now inadequate to address 'wicked problems' in the real world:

The importance of policy has grown because the challenges that we face are more complex and the challenges now may be termed or coined in terms of the "wicked challenges", and these

wicked challenges are such that they can't be solved by a purely reductionist approach... And for the best part of probably two decades, much of the science culture has been built around a kind of reductionist approach, and those reductionist approaches - although they are going to be very powerful - and we see this with COVID, [we] need [a] much more holistic approach.

The problem might run even deeper, as some former interns suggested. Several of them came away from their internships with a different understanding of how abstract, insular and disconnected detached academic work can be from the outside world. One of them, in particular, discovered through their internship at Defra just how irrelevant and unusable most policy recommendations in academic papers were; they were just not granular enough to be useable. Finally, when some of my interviewees lauded the levels of collaborations in the Civil Service, they did so in contrast with the siloed and often lonely working practices of researchers.

Policy environments

In many ways, the problem of disciplinary insularity in academia mirrors the insularity and siloed tendency of workstreams and teams in the Civil Service. Notwithstanding that civil servants seem to work more collaboratively than academics (a learning point for a handful of the former interns I interviewed), there was also astonishment at how siloed they can be. One experienced adviser was initially shocked to discover that some civil servants working on the same floor had never met. Interviewees also stressed that opacity (or lack of transparency) and strong in-group/out-group dynamics appear to be the norm. Regarding the latter, several emphasised the importance of personal connections, not only between scientists and policymakers, but also within the Civil Service. Good personal connections are undoubtedly fundamental for building trust, multiplying work opportunities, and eventually having an impact as an adviser, but they are apparently equally as important between civil servants for project opportunities and promotions. In the case of science advice, one experienced adviser told me that civil servants tend to go back to the same people time and again, which can create barriers to entry for new blood.

One factor that likely contributes to the heightened value of personal relationships is the (very) high turnover in jobs within the British Civil Service that interviewees observed. An experienced adviser went as far as claiming that the institutional memory of Whitehall is effectively outsourced to consultants and advisers, because 'just about the time they understand most of it, they then apply for a post in a more senior position in another government department'. They joked about how Gordon Brown outlasted his civil servants in the Treasury. This hypermobility in career progression pathways further incentivises civil

servants to be jacks of all trades, masters of none. That was a process of transformative learning for one former intern who had expected greater value to be placed on subject matter expertise.

Interviewees contrasted the generalism in the Civil Service with ultra-specialisation in academia, with one experienced adviser saying that civil servants 'are supposed to be generalists who can master a brief or brief Ministers regardless of the subject'. Within such a work environment, it appears that civil servants are socialised to always be on the lookout for new opportunities and that, given their mobility, their only consistent anchor is their personal networks. Conversely for academics, while personal relationships matter too (e.g. for research collaborations), the existence of tenure and promotion committees contrasts sharply with the Civil Service. This means that - in addition to the generalist versus specialist norm divergence - academics working with policymakers can be quite surprised by the high mobility of their counterparts.

Academics seeking to engage with policymakers also have to learn to navigate the Civil Service's culture of secrecy and discretion. One learned how difficult it can be to be informed about the policy cycle and current policy concerns within Whitehall if you are not on the inside or, at the very least, at arm's length. In a similar vein, a former CSA spoke about the notable differences between being inside government versus being on an external advisory committee - explaining that you just cannot get the same amount and quality of 'feedback' but, on the flipside, as a quasi-civil servant, you are more restricted in what you can do as a CSA. This was confirmed by an experienced adviser who said that if 'you are sort of working four days a week or five days a week in Whitehall, clearly you understand everything, you're very much an insider', whereas they were 'slightly more removed, and although I've had a lot of contact and experience with Whitehall, I've never actually been on the inside'.

Such in-group/out-group dynamics make sense when considered alongside the insularity of - and strict confidentiality norms within - the British Civil Service. Several former interns referred or alluded to the Civil Service Code (of Conduct), for example. While trying to recall the contents of a meeting, one of them told me: 'I can't even remember what it is and I don't think I can say it anyway because I read the civil servant thing <h>'. Interestingly, though, none of the four core values laid out in the Code refer to confidentiality or sensitive information⁴⁸. Indeed, these are largely oral traditions. Matthew Flinders speaks of the 'no surprises rule' as an important part of the Whitehall jargon (see SAPEA, n.d.-b): this connotes

⁴⁸ Instead, they are 'integrity', 'honesty', 'objectivity', 'impartiality' (see Civil Service, 2015)

a basic assumption within Whitehall that any conversation is off the record unless explicitly stated otherwise by all parties, and consent should always be sought before publicly disclosing information (ibid.).

The reasons for - and practice of - discretion in the Civil Service was a major learning point for the former interns I interviewed. As a result of their internship, one of them now appreciated that the Civil Service has to be more careful about what it does and does not communicate to the public, because of the potential unintended consequences. They recalled witnessing discussions around the disposal of electronic products and coming to terms with the delicate balancing act between being truthful with the public and risking setting off alarm bells. This was a moment of transformative learning for them. One experienced adviser sympathised with some of the secrecy in government, adding that government should explore different options, including 'something that's absolutely awful', but that these discussions could not be open to the media or the public because they could easily be misrepresented. As they pointed out, 'to consider something does not mean to say that you're going to do it', and 'you might end up discussing things which you really wouldn't necessarily want the Daily Mail to know that you've discussed, or the Daily Mirror' - including discussions in scientific advisory committees.

In addition to high mobility, insularity, and secrecy, interviewees observed that civil servants are under significant pressure to deliver from various angles. A former intern recounted how they had not appreciated the extent to which policymakers are being pulled in different directions. They told me:

I was really impressed with the quality of person and the work commitment from everyone there, but they don't have time; they are really squeezed, and I think that was a big thing. These guys just don't have the space to go and spend four hours reading up on the literature; there's just no change... They're under a lot of pressure.

Reflecting on their (transformative) learning journey, they suggested that academics need to be 'more mindful of the wider context' and need to be more holistic and tolerant of the need to compromise. Although a former CSA, said that the push to compromise can sometimes go too far:

If you are in a discussion and you say: "Look, you can't do this because it's against the laws of physics", it kind of looks like you're not being a team player <h>; you're not finding the way to solve the problem. [Because saying "it's impossible"] could be career limiting, civil servants are pushed a bit to compromise on what they shouldn't really compromise on.

One experienced adviser - who worked as a civil servant early on in their career - was 'struck' by the fact that despite the place being full of PhDs, their 'ability to sit back and muse' had disappeared. They had 'lost the academic approach of questioning and looking widely'. They recollected:

I thought: "my god, I could never be a civil servant, because they are so constrained and there's brilliant people here that you could see would love to be doing a research project on something, but they just don't have the resource or the time to do that".

Coming from a different angle, one experienced adviser - a systems expert - expressed sympathy for policymakers struggling with non-linear, complex systems. They explained that policymakers are often under pressure from the media to offer 'direct cause and effect relationships' and 'it's embedded in the system, that you should be able to make an intervention [for which] you can trace some of kind of causal relationship to an output'. In general, interviewees spoke of how they found civil servants to be highly solicited by different interest groups - often leading them to think in a more nuanced way about the space that scientific evidence can occupy (amongst other pieces of information) in policymaking. Civil servants are sometimes prey to the political ideologies of their bosses, but they can also provide a challenge function. This surprised a former intern who told me a story about an idea that came straight from the Minister and which the civil servants challenged and tabled - suggesting it needed further work and evidence.

Finally, an interviewee who did their internship at Natural England said that they did not quite expect it would be as bureaucratic. On that matter they said: 'I wasn't aware of actually how bureaucratic it was going to be and how difficult it was going to feel in terms of actually like making my presence have an impact at all'. Another experienced adviser said that '[civil servants] don't like changing things', suggesting the culture in the Civil Service can lead to institutional inertia or path dependency. Some interviewees spoke of odd and unhelpful jurisdictional overlaps in responsibilities (between government departments, for example). Interviewees spoke of rigid command lines and bureaucratic leviathans. This was illustrated by the learning experience of this former CSA:

There's no way that you can win an argument with [civil servants] if they disagree with you. There's no way you can. You just don't know how to play the chess game. You have to have them on your side and you have to work with the grain of them, I think. I mean, early on, ... [I caused] a few complaints because [I was] breaking the lines of command so to speak. I [was] going from [one] point in the organisation chart, talking to people that work for someone else [in other part of the chart] ... I was having coffee with a Director General - we were just discussing my role and things to do - and I sort of asked them: "Look, I'm getting this sort of issue about

whether I should be doing this or not". And they said: "well, the thing is [that if it] disconcerts them... you absolutely must keep doing it <h>'.

5.3.5 Party political culture

Policy is like drawing a map to work out how do I get from there to there? And when you draw a map... you use very delicate instruments: you have set squares, and compasses, and rulers, and it's very precise and all of that. And that's what policy is about. Politics is actually making that journey; it's going from there to there. And when you do a journey, and particularly if it's quite a difficult journey, ...you have much cruder tools, you have crampons and heavy boots. Sometimes you push people off and sometimes you have to entice them. I think the politics and the policy distinction, you know it's a bit crude, but I think it's a very useful distinction. People often don't understand it or think about it (experienced adviser paraphrasing Tom Burke, a former Executive Director of Friends of the Earth).

In this section, rather than attempt to provide a comprehensive account of how politics works, I instead lay out some key areas of 'the political culture' in the UK that contrast with both the academic and policy cultures I've talked about so far. Furthermore, I make a distinction between *politics* - which is pervasive in every sphere of life - and *party politics*, which is more identifiably organised, institutionalised, and partisan. Although only a fraction of my interviewees had had substantial exposure to this particular world at the time of interview (attesting to the relative separation of science advice from party politics). They included former CSAs, experienced advisers who had worked with senior politicians or Ministers, and others who had worked in a parliamentary context (either as a specialist adviser for a select committee or as an intern). These interviewees offered various observations about party political culture that distinguish it from the two cultures outlined above. Most of their comments related to either Ministers in government departments or members of the House of Commons, House of Lords, or Devolved Parliaments and Assemblies. The three major themes discussed in relation to the culture of party politics by my interviewees were: short-termism, responsiveness to external events, and the select committee system.

Experienced advisers, in particular, spoke of the short-termism that is pervasive in politics. One of them stated that 'short-termism always trumps - or almost always - the right thing to do in the long-term'. Another interviewee illustrated this issue with the example of the UK's general opposition to 'grandfathering', a policy that ensures the perpetuity of already agreed rules on existing projects; new rules would only apply to future projects. They explained that grandfathering helps with long-term infrastructure projects and bids by providing certainty to the parties involved. They claimed that the UK (unlike France, for example) refuses to provide that sort of certainty because there is a fixation on the idea that 'the government should be

able to change its mind at a moment's notice and completely reverse all previous decisions'. For a former CSA, short election cycles are mostly to blame for a lack of long-term vision:

It's very easy for politicians to deliver if it's short-term impact. It is horrendously difficult for them to have the courage to be able to deliver on long-term objectives, because they will no longer be in power. No one will remember them <h>. We'll remember that people didn't act, but in a way, it will be the usual blaming people that: "Oh well they should have acted and so on". Because of our electoral cycle, there is no incentive for politicians to act on evidence where the impact will only be felt in a long-term way.

Another former CSA argued that short-termism is also due to the speed of change in topical issues. As CSA, they enjoyed the shorter timelines and the feeling of impact, but everything was 'very ephemeral... It was no longer important a week later'; sensitive documents become 'old fish and chips paper' the moment the information hits the headlines. In general, interviewees observed shorter 'attention span[s]' in politics than in academia or policy - which can be jarring for less experienced advisers. For one former intern, short-termism was a major factor in their decision to not pursue a career in government after their PhD.

The above brings me onto the second theme, which is the level of connection and responsiveness to topical issues and events. Speaking about their learning in a parliamentary context, a former intern said:

It also kind of impressed upon me, I guess, how interconnected things are. And that it's quite important to keep your head to kind of to listen out for what's current in the news... You could see changes in the inquiries and things like that, in response to certain events.

Relatedly, one experienced adviser highlighted the importance of what they called 'ignition events' (i.e. dramatic events that spur political debate and action) and their role in creating policy windows. They stressed that issues might already be on the radar of policymakers and politicians, but it often takes that extra push from a highly mediated event to set the wheels in motion. Two other experienced advisers suggested that it seems to take a crisis to spur political action, with one of them citing the case of UK flood expenditure only increasing following a particularly bad flood, even though science advisers had been advocating for such an increase for years.

Unsurprisingly perhaps, the overwhelming majority of comments around political culture came from interviewees who had had exposure to parliamentary contexts. For instance, one experienced adviser told me that they used to attend select committee meetings purely for the sake of learning - and started doing so before they took up any advisory role. What they observed was that although the select committee deliberations are more 'superficial' than on

scientific advisory committees, they are also surprisingly not 'party-political'. They said that 'party politics doesn't come out very strong' in select committees. In fact, they recounted how they were initially 'struck' by the select committees' ability to work together and - with a 'good Chair' - produce unanimous reports which do not split along party lines. From watching Prime Minister's Questions (PMQs), they had expected a much more animated and politicised performance. Despite the wide variety of experiences, there was a general consensus amongst former specialist advisers that select committees at the House of Lords were far less party-political and/or partisan than in the House of Commons, with one experienced adviser saying:

[They were] sort of highly respected because, in a sense, they were - being the Lords - more like [an] expert committee... rather than being political. The Commons are definitely political and that's very important and it's got its value. The Lords were [producing] much more technical reports if you like.

The same interviewee noted that specialist advisers in the House of Commons sit at the back, whereas they sit at the table with the Lords in the House of Lords, which they said was suggestive of them being 'confident enough in themselves'. They found the physical distance in the House of Commons committees striking; for example, specialist advisers are not able to slip 'a note' to MPs. I return to the influence of sociomaterial circumstances on learning in Chapter 7.

Interviewees were quick to criticise politicians sitting on select committees. According to one experienced adviser, although the clerks were 'intellectually engaged' and very competent, the MPs were often (shockingly) disengaged - which they found 'quite frustrating'. They attributed it partly to the reward system in party politics, wherein the brightest and most engaged MPs would get noticed and swiftly promoted. On a similar note, a former intern in a devolved parliament complained about the lack of scrutiny and discipline with regards to parliamentarians' commitment to select committee work. Many of them would not show up. They spoke of one, in particular, who would often scroll down their tablet during evidence hearings, which they said was 'fairly shocking'.

Select committee members would also often ask 'silly' questions or read word-for-word the questions prepared for them by the research service, even if it had already been answered. They told me that although they generally appreciate the expertise of politicians in asking 'probing' questions, they still felt strongly about evidence hearings chiefly being an information-gathering space. In trying to understand their 'lousy' behaviours, the former intern suggested that 'maybe when they were first attending, that's how other people behaved and that's just kind of the culture'. Echoing the point about probing questions, a former

specialist adviser claimed they could tell who the (ex-)politicians were in the House of Lords select committees by the questions they asked, whereas others would 'just [be] after data'.

A more serious accusation came from a former intern, who spoke of clear cases of 'cherry picking of evidence' in select committee settings. They understood that parliamentarians represent the concerns of their constituents, but they were still 'surprised by how blatant that [overlooking of evidence] could be'. More often than not, 'it didn't generally matter what the evidence that was being presented was, they kind of made their mind up anyway'. They were perhaps a little naïve to begin with, as they expected parliamentarians to be more 'open-minded' and responsive to new evidence, like scientists. When I suggested that they might be projecting academic expectations, they said the following:

Me: You know, I don't want to sort of influence your response here, but you mentioned open-mindedness to changing evidence. To me that sounds like the ideal of academia or science, which perhaps doesn't fit that well with politics.

Former intern: Yeah, it probably... it probably doesn't, and that's probably why it was a shock.

Our exchange attests to the role of 'culture shock' in less experienced advisers' learning (see Section 5.5). Experiences in the select committee system could be a source of transformative learning, as exemplified by one of my interviewees who spontaneously and succinctly broke down the lessons they learnt as a specialist adviser. They described the role as one of 'a broker of information and helping translate information for MPs and Members of the Lords'. They said that, in this 'entirely political' environment, one learns that: i) 'there is a view as to what the answer ought to be before they even start these inquiries'; ii) 'so if you're going to come up with something completely different, you're going to be on quite a difficult position'; iii) you have to 'learn to how to balance the language' and 'you learn in the quite early days in those environments - which are highly political (they are not policy in that sense) - how to get messages across, have key information which they really can't deny'; and iv) 'you learn a huge amount of patience, which you probably haven't naturally got in those environments because you're thinking "why don't you just listen to me?" and "why do you refuse to accept what the evidence tells you?"'.

While some of these lessons are specific to science advice in the parliamentary context, others apply more generally to the cultural differences between the academic and party political cultures. In Table 4, below, I sketch a comparative table of the stereotypes of the three cultures - combining interviewees' observations and my own.

Table 4: A (speculative) table summary of the stereotypes of the three cultures based on interviewees' observations and my own.

Science culture	Policy culture	Party political culture
Somewhat isolated from outside world	Isolated from outside world	Plugged into outside world
Siloed		Connected, organised
Common values		Incompatible values
Somewhat transparent	Opaque	Quite transparent
Long timeframes	Short timeframes	Very short timeframes
Long-term perspective	Short- to mid-term perspective	Short-term perspective
Relative freedom to choose focus of work	Work mostly driven by governance issues of the day	Topics driven by events, public opinion, and political programme
Incremental progress		Abrupt and sudden progress
Cult of personality	Cult of competence	Cult of personality
Career progression based on outputs and popularity*	Career progression based on leadership and adaptability*	Career progression based on popularity*
Mostly peer validation		Mostly external validation**
Narrow expertise rewarded	Wide competency rewarded	Expertise can lend legitimacy
Scientific knowledge is superior	Scientific knowledge is important and useful	Scientific knowledge is weighed against others claims
Communicate uncertainties	Manage uncertainties	Craves certainty
Emphasis on accuracy in methods	Emphasis on accuracy of language	Emphasis on accuracy of strategy
Fear of being wrong	Fear of falling out of favour	Fear of being unpopular
Flattens trade-offs***	Explains trade-offs	Confronts trade-offs

*Career progression is, of course, also based on perceived competence

**Except within political parties

***Depends somewhat on the discipline

5.4 National political culture

Over dinner, I eventually said to this [German science adviser]: “do you get paid for being on the German commission?”. And they said: “yes”. And they got, I don’t know, 50,000 euros a year or something... I mean a big sum, plus a researcher, plus secretarial help. And they said: “what do you get?”. We didn’t even get a daily attendance allowance because the Chair wanted to be completely independent. And they just looked at me and said: “You British, you’d do anything for the Queen <h>” (experienced adviser).

In an exchange about their experience being on advisory committees, one experienced adviser told me: ‘there’s very few places I’ve learned as much about caricatured British [traits] <h> as I have on these advisory committees’. They identified three features of the committees they sat on which they saw as quintessentially British. The first was the ‘unspoken etiquette’ around being polite and respectful about each other’s respective subject matter expertise:

There are *usual assumptions that govern British advisory committees in particular*, which is a kind of division of labour; each expert represents a particular segmented area of work and *it’s really not polite to start transgressing and questioning another segment of work*, even when you can see that manifestly it’s not right. Because you’re somehow stepping on toes... So there’s a sort of *unspoken etiquette* that - although you’re supposed to be challenging - in fact no one does really challenge each other unless they’re in the same field (emphasis mine).

The second observation revolved around the strides one can make with a bit of humour, and especially self-deprecation: ‘if you make a joke at your own expense, you can typically expect to get something that matters further, better, when the agenda item comes up’. They added:

Even among scientists on an expert committee where the stakes are relatively low and they are all basically agreeing on something, [some people] will get quite irate about issues... - quite often in a suppressed or repressed British way - that are not really substantively that important. So, if you go out of your way to be collegial and self-deprecating... and open about your own agenda, then you can find surprising things happen.

Finally, they spoke of a tendency on British scientific advisory committees to ‘laugh at foreigners’. They mentioned an example of fellow committee members disparaging the lack of pragmatism taken by continental European counterparts (who were erring on the side of caution). The interviewee qualified further: ‘that’s a very British feature; feeling that the British pragmatic, empirical approach is somehow best’. In fact, self-deprecation and British pragmatism come up again in my analysis of Defra SAC (see Chapter 7).

When it comes to how science advisory institutions function abroad, while one experienced adviser with experience on UK advisory committees and a foreign committee told me that they

operate 'very similarly', other interviewees were quick to point out that there might be some significant divergences between countries. Speaking of their experience on a continental European committee, one pointed out how the committee in question was far more reactive to incoming demands from Ministers, and was used to faster turnarounds, than typical British advisory committees. Another deplored the arrogance of the British in their attempts to export the CSA model abroad. The experienced adviser who had told me about how to get invited into the policy world qualified their advice on the matter as 'very British', and that it should therefore not be extrapolated to other national contexts.

Several interviewees were cautious when it came to essentialising 'British' culture itself, pointing to the differences within the UK. One experienced adviser mentioned how science advisers need to be cognisant of the varying political contexts in the Devolved Administrations (i.e Scotland, Wales, Northern Ireland). As a case in point, another spoke of the 'different values and cultures in the rural economy' between Scotland and Wales. And yet another with science advice experience for the Scottish Government, mentioned that the institutional models that worked best there might not be fit for the UK at large.

All of these observations speak to Jasanoff's (2005a) idea of *civic epistemology* presented in Chapter 2. By way of illustration, one interviewee spoke of the differing attitudes towards infrastructure planning and engineering expertise between the UK, on the one hand, and France, Germany, and Spain, on the other hand. With regards to France, they said: 'there's a cultural difference about the role of infrastructure expertise and its relationship to government feeding through the Grandes Ecoles'⁴⁹. In the UK, this is perhaps partly accounted by the tendency in Whitehall to source engineering expertise in-house and the lack of consideration for engineering advice as a form of science advice in its own right (see A. C. G. Cooper et al., 2021).

On the whole, however 'Britishness' may be conceptualised, a certain degree of British cultural capital - or 'habitus' - will necessarily come into play in the interactions that science advisers have amongst themselves and with UK policymakers. For advisers and policymakers who have had significant exposure to the idiosyncratically British ways of working and socialising, there will be an existing degree of mutual understanding. The 'culture shock' I go on to describe below will therefore only be partial.

⁴⁹ These are specialised, state-funded universities in France. They are prestigious and most of the French political, administrative, and business elites have attended them.

5.5 Disorienting dilemmas as culture shocks

In the previous sections, I delineated the three cultures - offering some sketches of what norms and values compose them. In doing so, I presented some examples of transformative learning around these cultural differences. Here, I would like to elaborate on the operationalisation of the concept of transformative learning within this cultural understanding of advisers' learning. Transformative learning can occur when advisers find unexpected alignment between the policy or political culture and their own, and there was some evidence of that being the case for my research participants across levels of experience. However, in line with Mezirow's (2000) idea of the *disorienting dilemma* (see Chapter 3), I want to draw attention to the challenges of dealing with a situation for which one has not been prepared or with which one has not previously confronted. For analytical purposes, Taylor (2000) calls these disorienting dilemmas 'triggering events'. By focusing on anecdotes as the main sources of data on transformative learning (see Chapter 3), I also approach memorable events as a core tenet of *perspective transformation*⁵⁰.

Principally to ensure anonymity, I transformed some of my interviewees' anecdotes into fictionalised stories. As Willis (2019) suggests, 'elite interviewees are particularly vulnerable to breaches of anonymity' (p. 477). Unlike Willis (2019) though, I strive to keep the individual accounts rather than representative composites. I discuss the strengths and limitations of this approach in Chapter 8. Clear instances of transformative learning using this approach include this fictionalised story from an experienced adviser about their colleague:

The Minister was hours away from going on-air. A topical question on a health issue came from the Minister and was posited to one of my scientist colleagues. The *civil servant in question asked my colleague*: "What is the impact of X on Y? Could you give me the answer?". To which my colleague replied: "OK. *I'll go away and work on that, and I'll get back to you*". The civil servant interjected: "I'm afraid not. Sorry to disappoint, but *I need the answer within the next two hours*". I think *that was when my colleague realised that they were dealing with a completely different beast*. All the *scientific papers* - which rigorously followed the iterative process of the scientific approach, with hypothesis testing and refinement - *just weren't going to cut it for the politicians who need a summary on very short notice*. They also need the political side, they want certainty, whereas of course science is more interested in the uncertainty and then pulling that apart. So, I think *that was a big moment for them* (emphasis mine).

⁵⁰ 'Perspective transformation' is another term for transformative learning. It involves critical self-reflection on - and the transformation of - *meaning schemes* and *meaning perspectives*, both defined in Chapter 3.

Why this particular moment was the one that stood out, to the extent that they would tell the story to friends and colleagues, is not clear. And in fact, 'there is little understanding of why some disorienting dilemmas lead to a perspective transformation and others do not. What factors contribute to or inhibit this triggering process? 'Why do some significant events, such as death of a loved one or personal injury, not always lead to a perspective transformation whereas seemingly minor events, such as a brief encounter or a lecture, sometimes do?' (Taylor, 2000, p. 300). In the case of science advisers' learning, the two cultures idea offers us one way of addressing this problem. If we consider the idea of transformative learning as *culture shock*, then we might have some indications of why some events trigger perspective transformations and why others do not. Furthermore, instances of culture shock highlight those aspects of the policy and party political cultures that clash with the most valued norms in the science culture. As Cloud (2020) suggests, 'we can measure a norm's power in part by how outraged we become at violations [of it]' (p. 9). The more different the policy world turns out to be - compared to previous expectations, experience, and above all to the science world - the likelier science advisers are to undergo transformative learning.

In other words, my hypothesis is that the stronger the culture shock, the greater the chances of perspective transformation. This fits neatly within Mezirow's conception of transformative learning as the transformation of *meaning perspectives*, which 'often represent cultural paradigms (collectively held frames of reference)' (Mezirow & Associates, 2000, p. 18). In Section 5.3.1, I argued that these shared meaning perspectives are captured by and contained within (ideal-typical) stereotypes. Consider the following two anecdotes:

In my own evidence statement, I had to caveat certain things because of the implications of saying something that I wanted to say, even though there was research to back it up... [And] now you've brought it up, *I remember that was a really big day for me*. Kind of *going home and realising*: "oh wow, OK. You definitely *can't say whatever you want because you have to be really mindful* that that might implicate the government and when you work there that's on you and... *you're an impartial civil servant, and so you have to go with what the government wants to do*". So, I do think... it would involve a lot of compromise because you're answerable to something else, not just the science (former intern, emphasis mine).

I remember, very early on, soon after I'd gone and started working for the government, one of my first meetings was with a Minister and civil servants. We were talking about the administration's environmental strategy and I mentioned food security. I was trying to make the point that there are important trade-offs between food security and biodiversity. And there was complete silence around the table. *I can remember after that thinking: "I'm on a different planet from everyone else in the room* because the way I look at life - or the *way I look at what's needed from science* - is

very different. And that we are all about the long term and policies are about the short term". That experience stuck with me (former CSA, emphasis mine).

In the first story, the former intern has a profound realisation of what it means to be a civil servant. They can no longer take for granted the sort of freedom of expression that is commonplace in academic circles; a clear instance of culture shock. In the second story, the former CSA confronts an awkward manifestation of cultural distance. From that experience, they conclude that their understanding of policymakers' needs and the jargon that they are so used to deploying will not resonate with their new policy colleagues. In line with the two-worlds hypothesis (see Section 5.2), they describe their feeling of estrangement as being 'on a different planet from everyone else in the room'.

Unfortunately, the anecdotes recalled are not always this perfect; they do not always refer to singular trigger events. Sometimes they invoke events as illustrations of a longer process of transformative learning. With regards to moving from one culture to another, Mezirow (2000) says the following: 'transformations may be focused and mindful, involving critical reflection, the result of repetitive affective interaction or of mindless assimilation - as in moving to a different culture and uncritically assimilating its canon, norms, and ways of thinking' (p. 21). What this means for the qualitative researcher is that there is a challenge in identifying stories of culture shock where the transformations have not been sudden and are not attributed to a singular event, but rather several. A good example is the following fictionalised story from an experienced adviser:

When I went into it first, *I was very naive*; I didn't really understand the difference between research and scientific advice. I kind of thought they were sort of the same thing. [I thought] that people wanted to know everything that I knew <h> about the details of some bit of science. And *it took me a long time to understand* all that, and *I think I understood it by observing some people who were really good at it*. I can still *remember a few of those sorts of moments* when you're listening to somebody talking, and they just *say something that makes you [have] a moment of clarity...* I remember once going to a talk where someone put on a bit of a show by showing us all the different ways we could measure habitat degradation, and some associated datasets that we have at our disposal, and then went through them all - applying some different criteria to determine their usefulness. In the end they ended up with just a few, maybe three or four. *That definitely influenced my thinking* on the importance of finding the right proxies for decision-making, whether for practitioners or policymakers. *Those sorts of things generally had a big effect on me*, and that's the sort of thing that people have to think about. *It's very different to doing science* (experienced adviser, emphasis mine).

While it is clear from this story that there was transformative learning around the differences between research and science advice, and between what is useful and what is scientifically desirable, the interviewee claims that they had several moments of 'clarity'. Here, I acknowledge that when the relationship between events and transformative learning is less obvious, it is harder to disentangle what transformations have occurred through assimilation overtime - and in the various encounters with the foreign culture - and what transformations have their roots in a particularly challenging event or singular point in time. Whether certain events led to a straightforward transformation or a profound transformation - as a consequence - remains difficult to determine second-hand. In this thesis, I have therefore chosen to avoid making any such judgments, preferring to speak of transformative learning in broader terms instead (as already stated in Chapter 3).

5.6 The cultural encounter as a model of learning

I have argued that we can transpose C.P. Snow's 'two cultures' metaphor onto the experience of academics learning to become science advisers. I have shown how policy and academia can be conceptualised as two distinct worlds, with their respective cultures. It follows that if they are to be taken as two worlds, then there are some implications for travel, learning the local dialect, forms of anthropomorphism, and so on. More importantly, at the intersection of these worlds there are various possible *spaces of encounter*, some of them on each other's respective planets, and others in neutral zones or natural satellites, where inhabitants of both worlds meet. These spaces of encounter are therefore also spaces of mutual learning. When they are located on one of the two worlds, foreigners learn through *dwelling* in the designated space for a period of time. As a core strategy for learning, the importance of dwelling is manifest in the proliferation of secondments, placements, internships, exchanges, and is in all likelihood a foundational rationale for the CSA system in the UK. Here is what one experienced adviser had to say about the CSA system in that regard:

I think the majority of [CSAs] *are really good at their job*, and when they are good at their jobs *they absorb the culture of Whitehall*, but also bring with it the external view. So, they are not career civil servants; they are people who are civil servants for a limited period of time, who *quickly get to understand how policy formation works* and are then in a really good position to help policy formation access the best of evidence (emphasis mine).

And here is what a former CSA told me about the power of internships:

We put in place a system whereby we had *internships where scientists came in and spent a few days with a policymaker* and that *opened their eyes to the differences*. I mean, ideally, we'd want

to have the policymakers go out and spend time with the scientists... but we never achieved that because policymakers were always too busy (emphasis mine).

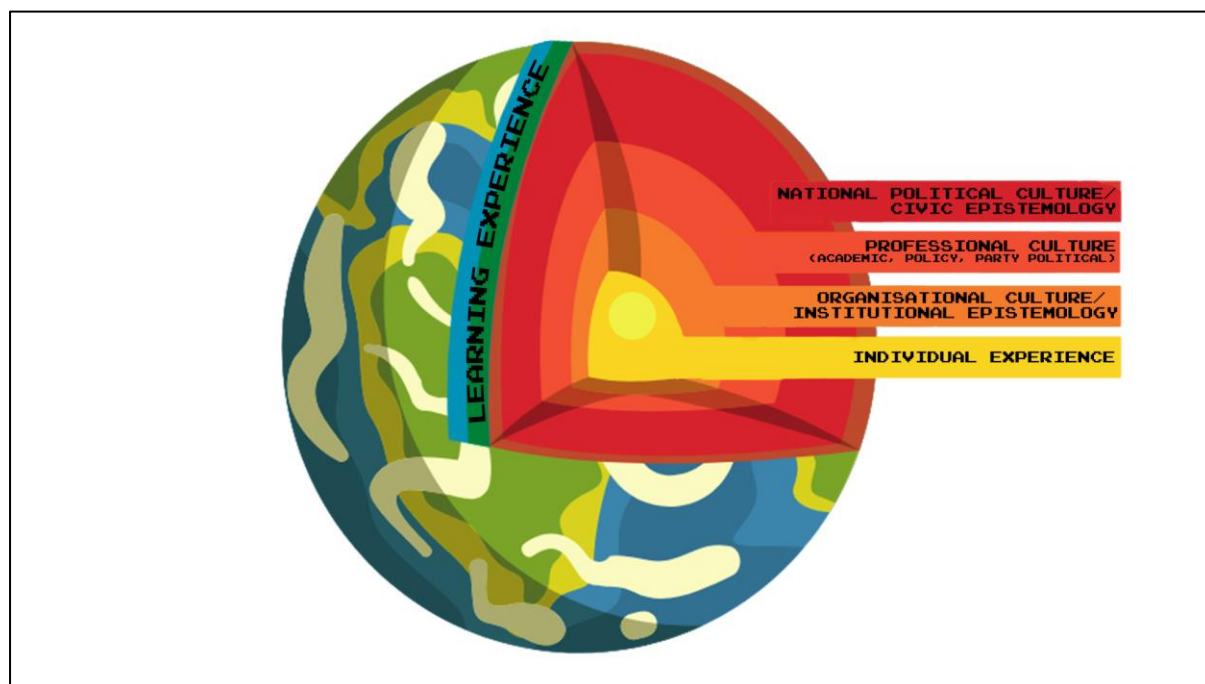
Whilst the two-worlds hypothesis enables some fruitful analogies, I have argued that we would be best served returning to the idea of the two (or three) cultures. Within that framework, what is happening in the aforementioned spaces of encounter is effectively a *cultural encounter*. Before talking about the cultural encounter in general terms, I first had to first delineate the ways in which science, on the one hand, and policy, on the other hand, might be understood as cultural entities in their own right. Based on my interviewees' recurring boundary work with regards to policy versus politics, I chose to outline a third culture which I called *party political culture*. To attest to the existence of these cultures, I focused on the various stereotypes suggested by my interviewees and proposed that stereotypes (while inherently flawed) can offer some legitimate insights into pieces of the cultural puzzle. I contended that researchers can treat these as 'ideal types' - a set of discernible characteristics shared by a given social group for analytical and comparative purposes. I went on to lay out some of the common and most interesting stereotypes presented by my interviewees, pinpointing those most clearly related to moments of learning. I organised these various stereotypes into three broad categories: characters and traits, attitudes, and workplace norms.

I then outlined some of the characteristics of the party political culture which distinguish it from the policy and science cultures. I also briefly touched on the Britishness - or the specific idiosyncrasies - of the science advice ecosystem in the UK and its implications for learning. In Section 5.5, I took a step back to discuss the bigger picture on the cross-cultural learning experience of advisers. I reminded the reader of Mezirow's idea of the *disorienting dilemma*. By considering the disorienting dilemma within the context of intercultural exchange, I proposed that we can think of it as a moment of *culture shock*. The culture shocks experienced by some of the former interns and/or experienced advisers earlier in their careers, were manifold and would often trigger transformative learning; essentially a reframing and recalibration of their cultural expectations. I offered some examples of culture shock anecdotes and explained why some of those stories were fictionalised.

Considering all of these moving parts, a cultural model of advisers' learning will necessarily be multi-layered. I have identified four levels or clusters across which the learning experience of the adviser occurs and is organised (see Figure 7 below). The first and innermost level is the personal, individual (or psychological) experience which will vary from one person to another. The second level is the organisational culture (or institutional epistemology) within which people have worked or with which they have interacted (discussed in detail in Chapter 7). The

third level is the broader professional culture that these organisations perpetuate or challenge - in our case, the academic, policy, and party political cultures I have described. The fourth and final level is the national political culture (or civic epistemology) within which all of these other levels are situated and operate. The learning experience of each individual adviser cuts across and is confounded by these various levels.

Figure 7: The cultural encounter model of learning, from the individual to the national



Within this model, the learning experience is - to a certain extent - divisible into different types of cultural encounters, with some having a greater impact than others on advisers' (critical) self-reflection and recollection of events. In talking about their experience, some advisers might put more emphasis on the organisational cultures they were familiar with, whilst others might speak more about advice at the system level. I found that advisers who had had a mix of roles across the different parts of the advisory ecosystem would often speak about the more meta or bigger picture cultural similarities and differences. Conversely, some former interns struggled to extrapolate or go beyond discussions centred around the individual organisations they engaged with. Interestingly, virtually all interviewees were comfortable talking about organisational or broader cultural groupings (academia as whole, in particular). Conceptualising advisers' learning as a phenomenon of cultural encounter unlocks a conceptual toolbox composed of vocabulary from sociology, anthropology, and social psychology (amongst others) that we can draw on. For instance, the concepts of *acculturation* or *enculturation* are particularly helpful. According to the *Open Education Sociology Dictionary*,

acculturation refers to the 'the process and resulting changes that occur when two or more cultures come into contact' (Bell, 2013a), whereas enculturation is the 'process of an individual or group learning and adapting to the norms and values of a culture (or subculture) in which they are immersed (e.g. learning a new language or clothing style)' (Bell, 2013c). The cultural encounter model also opens up some interesting avenues for research, such as the study of placements and internships as dwelling (which I discuss in relation to longitudinal diaries in Chapter 8). I use this terminology and allude to the model in the remainder of the thesis.

6 The skilful adviser's journey

In the previous chapter, I established the ways in which we might conceptualise the science-policy relationship as one between two distinct cultures, with their respective (professional) norms and values. Within that framework, I argued that we could to an extent equate advisers' learning to the experience of tourists or migrants - depending on the length of their dwelling in the policy world (i.e. short and periodic visits versus prolonged stays). Whatever analogies one might want to draw, the truism here is that advisers learn through assuming, performing, and reflecting on their various roles in the science advice ecosystem⁵¹. We can therefore expect advisers to have similar learning strategies to counterparts in pretty much any professional field. Those strategies might include scrutinising job descriptions or terms of reference, observing and talking with old-hands, ongoing trial and error, drawing on one's understanding of previous/similar roles, and seeking formal training.

However, in the specific case of science advice, less experienced advisers face several challenges in pursuing those strategies. Firstly, job descriptions are often inexistent or very vague, and the terms of reference advisers are provided with are generally hardly an adequate substitute. Secondly and as I have shown in the previous chapter, drawing on previous professional experiences can be ineffective or misleading due to incommensurable differences between the science and policy cultures (e.g. the idea that publishing is impact). Thirdly and in part consequentially, less experienced advisers cannot rely on formal training to comprehensively prepare them for what lies ahead; for the most part they will need to improvise and learn by doing.

That being said, advisers - like boundary organisations - remain 'tethered to both [the science and policy worlds], suspended by the coproduction of [their] mutual interests' (Guston, 2001, p. 405). Advisers have to please both ends of the tightrope they walk on. Their roles are therefore fashioned by the expectations and standards of both scientists and policymakers. Experienced scientists are already proficient at interpreting and meeting the expectations of their scientific peers. The steepest learning curve comes from their evolving perception of the demand side of their advice (Sarewitz & Pielke, 2007). How advisers perceive the demand side is manifest in their descriptions of what they think their role is (descriptive) and what they think it ought to be (normative). Through their experiences, they learn what sorts of

⁵¹ Malcolm Knowles' (1984) work on *andragogy* underlines the centrality of learning new (professional) roles in adult learning, in general. Lave and Wenger's (1991) work on *legitimate peripheral participation* sheds light on the ways in which apprentices (and newcomers) gradually move from the periphery of a community of practice to its centre, contributing to its reproduction.

profiles and behaviours are rewarded by their policy clients without antagonising their peers. They learn to reconcile their initial motivations with the constraints they confront along the way. In essence, they learn to become skilful advisers with realistic expectations.

In this chapter, I adopt the perspective of a recruiter and attempt to define the ideal profile and curriculum of a skilful adviser. To do that, I seek to answer a few basic questions. What were the main ways experienced advisers got engaged in science advice and why? Which skills did they already possess and which ones did they need to develop? Which character traits (or soft skills) were most helpful to advisers? What did these advisers have in common which contributed to their success? These questions loosely structure the sections that ensue. I start with an analysis of the different avenues into science advice in the first place.

6.1 White coats to Whitehall

In the following sections, I discuss two principal - and largely individual/personal - aspects of the adviser's (learning) journey from academic researcher to science adviser: i) interviewees' motivations in pursuing science advice opportunities across levels of experience, and ii) experienced advisers' career trajectories. Whilst these different learning points provide some indications of how early-career researchers might best organise their careers to maximise their chances of success in science advice, the experienced advisers I interviewed were equally adamant about the amount of luck and serendipity involved in their own success. Furthermore, because motivations are often concomitant with incentive structures, their analysis is of particular value to readers interested in academic culture reform.

6.1.1 Entry points and career pathways

As one experienced adviser put it, involvement in policy advice can come 'from all sorts of avenues'. The majority of experienced advisers interviewed had come in through more formal processes - with a first appointment as a member of a committee or specialist adviser to a select committee, for example - and only a minority had very informal engagements to begin with. I note that this might be a residual effect of my sampling strategy (see Chapter 8). Despite having different starting points, virtually all of the experienced advisers ended up having a mix of both formal and informal interactions with policymakers. Interestingly, most of the experienced advisers also assumed roles in policy for science or science management throughout their career - for example sitting on or presiding over various research councils and learned societies - suggesting a link between roles in policy for science and science for policy.

Very few of them mentioned extensive experience in public engagement and science communication - implying that there is a relatively strong boundary between science communication and science advice. Whether that boundary is built because of advisers' individual preferences (e.g. feeling more comfortable in a policy-facing than public-facing role) or because those two areas of work are perceived as incompatible is yet to be determined. Finally, those who had had experience with policy at an international level (which is beyond the scope of this thesis) pointed out that it was quite different from their national-level policy work.

From what I could gather, some of the experienced advisers were approached by head-hunters or recommended by colleagues, while others applied to positions through regular channels. For example, at least two of the former CSAs were headhunted for the job (with virtually no existing experience in science policy) and one SAC member was invited to apply for a position on the committee by the then Chair, who they knew through their work on a common topic. One experienced adviser who came in through the ad hoc, informal route, said that 'slowly overtime you build up contacts and people who trust you. And then you get asked to do things that are closer to the policy process itself, and not just about giving the policy process a particular piece of information'. Although not the case for them, this experienced adviser also suggested that one of the ways into the policy world is through speaking at conferences or events where there are policymakers and getting to chat with them afterwards.

A couple of experienced advisers got invited along to things simply for lack of competition (i.e. there were not many other people who studied similar things and/or had similar skillsets), albeit that is probably far less likely nowadays with the much bigger pool of researchers to pick from in the fields of sustainability, climate, and environmental science. Finally, some experienced advisers initially got engaged by undertaking research commissioned by government bodies themselves (e.g. Defra or the Environment Agency), or else by supervising PhD students co-funded by research councils and government agencies.

Several experienced advisers expressed that one needs a certain level of seniority or experience in science and/or science management before engaging with increasingly higher levels of policymaking. Their views were somewhat contradictory because they were also broadly supportive of early-career researchers getting their foot in the door as early as possible. For instance, one of them said:

I think when you're early-career it's a bit harder to free up the time, because it does take quite a lot of time. And you know people who are doing PhDs or new post-docs obviously want to concentrate on the science. I also found that in a lot of the policy work that I did... you do need

quite a lot of experience, which you obviously build up. I'm not saying at all that early-career scientists shouldn't get involved, I absolutely think they should, but I think, for me, I felt more at ease when I had more background to do it.

Another interviewee argued that an advisory committee needs to be composed of 'people with a lot of experience'. Yet another spoke of the importance of multi-sectoral experience, saying that advisers have to be able to take the '360-degree view' and that they were 'slightly concerned that people go straight from PhDs into big picture thinking without having a grounding in something that is more rigorous'. These interviewees did not however provide clarity on how an early-career researcher could then come through the committee (or other) route to build that experience in the first place. It was perhaps not so clear what these experienced advisers meant by 'experience' and what kinds of advisory roles or committees they had in mind.

What most experienced advisers agreed on was the relative unimportance of whether or not one's research topic is policy relevant. There was some evidence that doing policy-relevant or applied research helped from a skills and mindset perspective, but seldom for my interviewees did the research itself create the advisory work opportunities. Only about half of the experienced advisers I interviewed said that their research and the work they published was policy relevant. For one, publishing around the time of a UNFCCC COP meant that 'the occasional policymaker [would come] to us with questions or requests for data'. For another, the realisation that their 'very fundamental science' was 'societally relevant and policy relevant' was a crystallising moment - pointing to possibly widespread flaws within academic circles on what constitutes policy relevance in the first place. Relatedly, interviewees suggested that being the foremost expert might not be a determining factor in getting the job. This was evidenced by the story of one experienced adviser who was invited as 'an independent scientific expert' to a planning exercise, despite only being an expert on the topic insofar as 'in the valley of the blind, the one-eyed man is king'.

6.1.2 Motivations

As a grounding exercise, my second question to interviewees was nearly always about their motivations (one of the only directed, structured elements in my interviews). As expected, their responses were varied but they nevertheless could be organised into some common themes that I outline below. First and foremost, surprisingly few of my research participants explicitly stated the normative position of wanting to see more science inform policymaking as a primary motivation. For example, a former CSA put it to me quite mildly: 'I think the strong motivation was to see knowledge being used effectively or at least knowledge being

made available to policymakers and ministers so that they might choose to use it'. A far stronger sentiment came from a couple of experienced advisers who told me that they saw it as their duty to address the gap between the best science and the decisions being taken, or at the very least to do more than many of their colleagues. As one recounted:

I thought that scientists were not actually doing their job - in a way - by publishing peer-reviewed papers that honestly not very many people read. And we kind of operated in parallel to policymakers making big decisions on science that they did not necessarily understand, or science that was not fit for decision-making. So, I wanted to sort of fill that gap a little... I thought it was my job to do that. You know, policymakers take decisions about public policy and my job is to bring the science to inform these decisions.

In total, only five interviewees (four experienced advisers and one former intern) mentioned a sense of duty or responsibility as a motivation to engage. One such experienced adviser felt they had a duty to give back after a 'successful and enjoyable scientific career... funded by the public purse'. A social scientist felt strongly about the underrepresentation of social science in policy circles, seeing it as a duty to demonstrate the value of social science 'in the public realm'. The only former intern in question felt they had 'a moral imperative to try and use your knowledge to contribute to really important decisions'. Finally, and perhaps most unexpectedly, one experienced adviser attributed their motivations to a 'degree of patriotism'. Other experienced advisers said that their sustained engagement could largely be attributed to the fact that they found the policy work 'really interesting', 'fascinating', and so on. For example, one of them said they applied to be the Chair of an advisory committee because it was fun, 'and by fun, I mean it's serious, it's important, it's intellectually engaging and it involves nice people'.

A larger number of interviewees spoke of the desire to (learn to) make their research more policy relevant or, at the very least, apply their research beyond immediate academic circles. Former interns appeared to be more concerned about how their own research might translate into policy, whereas experienced advisers seldomly spoke of the translation of their own research per se⁵². By way of illustration, one experienced adviser spoke of their personal motivations being different from many colleagues' desire to 'lob [their] stuff out of the shiny, white science box into the messy Whitehall box'. Instead, they assured me that translating

⁵² I see at least three potential reasons for this difference: i) scientists' interests and research cover a greater range of issues in the later stages of their careers; ii) more experienced scientists - and especially science managers - develop a broader understanding of scientific research, at a macro level; and iii) experienced advisers often speak for whole areas of science that largely exceed their specific research domain (sometimes even entire disciplines).

their own research for policy was never a particularly strong motivation for engaging in the first place.

Experienced advisers variably told me that 'the love of knowledge for its own sake' is not enough or that they did not see 'much of a point in doing science if I can't have it applied'. Two social scientists shared the view that it is a given in social science that the pursuit of better understanding is linked to its potential applications. One of them said they were motivated to 'get policymaking closer to people's lived experience; that is get it focused on the things that really matter to people'. In a similar vein, an experienced adviser said that 'if you're interested in ecological science, then you are interested in management as well'. These three interviewees hinted at the influence of their disciplinary training on their motivations to apply research more widely (see Section 6.4 for more on that).

Despite the cynical remark by one of my interviewees that 'usually the immediate political focus is on who's going to get the OBE next <h>', very few of the motivations mentioned were self-serving. I suspect that some of the interviewees were ashamed or insufficiently trusting to share the more self-interested motivations at play. One former CSA did however admit that the opportunity for further funding of their research group was one of the initial motivators of their early engagement. A social scientist also mentioned that it was 'flattering' to be appointed to a committee. Former interns were rather more forthcoming, with the majority citing the exploration of career options as a principal motivator for doing the internships. One, in particular, wanted to see where they might best fit given their interest in both policy and politics.

Half of the former interns also variably spoke about their motivation to 'learn more about how it all works'. Some had heard good things about the policy internship schemes from peers and saw them as a good opportunity to understand how government and policy work in practice. One said that they 'selfishly' hoped the internship would offer them opportunities to disseminate their research, and several said they were incentivised by the funding extension that came with undertaking the internship. I would argue that these are very reasonable extra considerations, which closely match the incentive structure and purpose of these UKRI internships.

While all interviewees recognised the importance of policy, only a couple of interviewees framed their motivation to engage as an internal drive to 'make a difference' or 'do something

for the good of the world'⁵³, and only five (two experienced advisers and three former interns) spoke of an ongoing involvement in politics being a motivator. Speaking about the more general desire to have an impact, one experienced adviser suggested that talking with policymakers is 'immediately attractive, because you have the ability to understand the questions that they are asking and then to try to answer some of them or... point out [that they are] the wrong questions, because they already know the answer to [them]'

Some interviewees were far more specific in describing the problems in the science-policy relationship they sought to address. One experienced adviser suggested that despite its monumental importance, 'the interface between research and its various stakeholders [is]... a rubbish interface at the moment', and that they were motivated to improve it. Another mentioned saving science from itself as principal motivation, explaining that 'science was being presented as if it was neutral, but it absolutely wasn't in those [policy-facing] areas' and that the denial of the 'gradients of power' ultimately harmed the epistemic authority of science in the long run.

6.1.3 Luck and serendipity

In parallel to some of the more predictable and tractable career moves mentioned above, a majority of the experienced advisers interviewed highlighted the significant part that luck and serendipity had played in both the success they enjoyed in their scientific careers and in their policy engagements. One said 'I've been mind-bogglingly lucky my whole career', while another recounted that '[I've] been incredibly lucky. Through no merit of my own. I've just been in the right place, at the right time, during the right sort of period, inadvertently with the right kinds of connections to get myself in'. In response to a question about their past engagements with policymakers, another replied: 'well, it was accidental<h>; I never planned it, it was never something I thought I would ever want to do'. In a similar vein, a former CSA who was headhunted said the following:

Here I was, having this opportunity, which was just wonderful, of dropping into that world and talking with people at a level that I could never have hoped [for]... I mean if I'd gone into those worlds then it would be very unlikely for me to do so well as to be at the table I was then at, as a Chief Scientific Adviser.

Interviewees offered accounts of scientific advisory committees looking for people with the particular skills or research expertise that they happened to have. Some mentioned instances of word of mouth, with one experienced adviser saying they had been invited as a specialist

⁵³ For the interviewee who said this, it was a learning journey for them to consider policy advice as an important pathway for achieving those goals.

adviser for a select committee inquiry simply because someone they knew recommended them. Another experienced adviser told me they had been lucky to have worked with senior scientists who were plugged into policy advice and to have had them as role models.

Nevertheless, interviewees also suggested that the times have likely changed since the early days of their journeys as science advisers. One of them reminded me that because of the increasing formalisation of many advisory roles and processes, the kind of 'luck that might have existed in the past, with a tap on the shoulder, is much less prevalent today'. And 'the chance that you work on something, as a research project, that is kind of policy relevant - at a particular point in time - is just vanishingly unlikely', said one of the experienced advisers I interviewed. Weighing all the complexities, an interviewee told me that the only piece of advice they could ever muster for early-career researchers was: 'hang in there <h>... there's a lot of luck involved'.

As another factor of luck or serendipity, experienced advisers also spoke of the importance of the political context they initially came into - with several highlighting the unusual extent to which the Blair government was favourable to diverse and institutionalised science advice. There were many factors for this enthusiasm, including - amongst others - residual science-policy challenges regarding BSE ('mad cow disease') and GMOs, as well as the foot-and-mouth outbreak of 2001. One of the social scientists told me that they got involved soon after the BSE crisis which had 'massively undermined both the confidence in the [science advisory] system, itself, as well as the public trust in that system'. They claimed that a (critical) social scientist, like themselves, would not have been invited into the science advisory system if it were not for the political context. It would appear that the post-BSE environment, under Blair, was conducive to advisory committees with highly multidisciplinary membership and a lot of stakeholder engagement. There was also an unprecedented amount of formalisation of science advice under Blair's consecutive governments, according to one of my interviewees. Another interviewee got involved under Thatcher, who they said had respect for non-partisan science.

Finally, an experienced adviser claimed that we are currently living a moment for climate change policy and for environment issues in general, and the opportunities for social science to contribute beyond a 'behavioural psychology approach' are growing. This was echoed by a former intern who told me that they could feel a 'real sense of motivation' within their team, trickling down from the decision of the UK government to take a leadership role in the international climate arena (e.g. with COP26). It would appear from the above that a key part of the learning experience for those on the journey from academic to science adviser is an

appreciation of the limits of one's own ability to control, influence, or indeed orchestrate opportunities for policy engagement.

6.2 From skilful researcher to skilful adviser

Another part of the journey is the ongoing discovery of what the role entails. Academics might first come into the role with a set of expectations or assumptions that they will then need to recalibrate in view of their experience in practice. For some, this will be a transformative learning experience, whilst for others the realities on the ground will not deviate greatly from their instincts. For example, while one experienced adviser described their first engagements on a committee as a 'masterclass' where they 'learned heaps' from colleagues and especially from the Chair, another said they had encountered no difficulty in adjusting to the policymakers' expectations and align those with their own. Although my interviewees presented both descriptive and normative accounts of the role of a science adviser, they unfortunately offered little about how their understanding of the role had changed over time.

This was partially due to me not pushing them in that direction and to the *recollection* problem discussed in Chapter 3. This is significant because, as I have shown in the previous chapter, less experienced advisers' initial expectations of what their role might and should entail do not exist in a vacuum. Instead, they are an interplay of personal worldviews and prevalent stereotypes in the main professional culture they have been used to so far. For example, a former CSA said that 'general perception is that the Chief Scientific Adviser will be much engaged with doing science' and they had to learn that this was not the case. In fact, this calibration of expectations around the nature and remit of the role of science adviser is probably one of the most meaningful aspects of their learning. From a methodological perspective, diary research seems most promising at getting to the heart of changing expectations overtime (see Chapter 8).

What interviewees did talk about at length, however, was the range of roles and responsibilities that an adviser might have. Especially given that clear job descriptions are scarce in this area of work, the discovery of just how broad the remit of an adviser can be was clearly a point of learning for many. In my interviews, I spoke of advisers' many 'hats'. Here, I have opted to talk about skillsets or skill profiles that advisers are expected to have and the extent to which they diverge from their existing academic professional toolkit. It goes without saying that the roles and skills required also largely depend on the tasks at hand, where in the ecosystem of science advice an adviser is positioned, general leadership and trust, and the organisational culture within which they work.

The nuances can be quite significant. For instance, a former CSA told me that the GCSA - the role model of a science adviser in the UK - has broader 'terms of reference' than departmental CSAs. Except that departmental CSAs' roles are not uniform across government. Referring to the House of Lords' report on CSAs (i.e. Select Committee on Science and Technology, 2012), another former CSA spoke about the considerable differences in departmental CSAs' power and remit depending on the government department. The interactions between roles and organisational cultures are addressed in the following chapter. In the following sub-sections, I have split the skill profiles into four: i) research skills, ii) communication skills, iii) managerial skills, and iv) political acumen. They are often a combination of both hard and soft skills⁵⁴.

6.2.1 Science advice is about research skills

The first skill profile follows Jasanoff's (1994) idea of peer review as a common practice of science advice. In her research on the US Environmental Protection Agency and Food and Drug Administration, she found that peer review in regulatory science was seen to assure 'good science', despite not necessarily having the same goals or effects as in academic publishing⁵⁵. On the role of adviser as reviewer, a member of HSAC told me:

A lot of the real detail is done by the people in the departments. And generally, I've always found they do a pretty good job. So, really, a lot of the advice we're offering is like a review really. You know, "is that document fine? Does it get the balance [right]?" [This applies to] when we have written documents about specific things. So, yeah, I mean we've been asked for our opinion on particular papers... And I think that's often been where the committee's been at its best really.

Not only is this interviewee describing the role of adviser as a reviewer, but they are also suggesting that science advisers work best when they are asked to peer review. Similarly, a Defra SAC member at the time of the interview said that the SAC sometimes acts as a 'sounding board' for the CSA or 'like a peer-review group' for Defra civil servants. As evidenced by the anecdote of an experienced adviser, the role of reviewer is not only restricted to formal advisory committees: they recounted a story in which a senior civil servant called them to ask them to review and edit a report twenty-four hours before it was due for publication.

⁵⁴ Hard skills refer to technical know-how and practices that can largely be taught, whereas soft skills relate to more intangible personal qualities and aptitudes (e.g. social skills). While there is an element of nature versus nurture in that distinction, both can still be learned and improved upon.

⁵⁵ For instance, she says: 'if peer review is most effective at cementing consensus among scientists of similar disciplinary training and outlook, then the chances are that the process will prove much less successful when it is carried out under uncertain theoretical and methodological constraints, as well as under pressure of politics and regulatory deadlines' (Jasanoff, 1994, p. 62). This was in plain sight with COVID-19 and the epidemic of pre-prints (see O'Grady, 2021 for example).

As peer reviewers, science advisers can act as critical friends - ensuring that the underpinning science and scientific assumptions are in line with the latest body of evidence. For example, one experienced adviser mentioned that a 'really good way to use science' is to challenge the government's existing (biodiversity) metrics or indicators in light of the newest scientific research. Another told me they learned over time to both advise and challenge Defra on 'the use of science and what scientific data says about different potential control policies, [and] about how you can improve the ones that you have got'. If we imagine this peer review process to be very similar to their experience 'at home', then there is very little learning involved. Indeed, one experienced adviser spoke of the competence in reading and assessing academic papers being directly transferable to advisory settings.

A few experienced advisers also spoke of the crucial role of questioning and reframing the question, as opposed to just providing answers to whatever questions policymakers put before them - which is arguably another area academics are proficient at. Finally, former interns who worked on evidence statements suggested that evidence statements are very similar to literature reviews. As one of them said: 'it's basically a mini literature review... Literature reviews were my expertise because I have done two or three before, ...but it was clear to them that I wasn't an expert in policy'. And given the growing importance of research synthesis in science advisory circles, academics are well-equipped to produce useful synthesis reports, according to one of my interviewees.

6.2.2 Science advice is about communication skills

The second skill profile mentioned by interviewees mentioned revolved around communication skills. Interviewees emphasised the skilful adviser's ability to broker, translate, and effectively transmit balanced information to non-expert audiences. In describing this skillset, most - including former CSAs - did a lot of boundary work, often reiterating that the role of the adviser is just to communicate the options and let decision-makers do the rest. The idealised behaviour interviewees spoke about closely resembled Pielke Jr.'s (2007) ideal types of the 'Science Arbiter' and the 'Honest Broker of Policy Alternatives'⁵⁶. Very much adopting the role of Science Arbiter, an experienced adviser speaking about their experience of CSaP meetings said the following:

⁵⁶ 'The Science Arbiter seeks to focus on issues that can be resolved by science, which may originate in questions raised by decision-makers or debate among decision-makers... The Honest Broker of Policy Alternatives engages in decision-making by clarifying and, at times, seeking to expand the scope of choice available to decision-makers. Unlike the Science Arbiter, the Honest Broker of Policy Alternatives seeks explicitly to integrate scientific knowledge with stakeholder concerns in the form of alternative possible courses of action' (Pielke, 2007, pp. 16–17).

It's [about] pointing [policymakers] to where they can find out past experience and evidence that they can draw on, but also trying to point out what I'm currently working on or what might be relevant to the things they are interested in. And sometimes, the match of interest isn't very close, in which case it's just an interesting conversation. But sometimes the interests are very close and, in those cases, I try and send them subsequent material. What then happens, I don't know.

Closely emulating the honest broker ideal type, one interviewee insisted that science advisers ought to state what the various trade-offs are 'very clearly' and do no more than 'just articulate what they are'. The most striking illustration of the honest broker approach came from the following description of the role of CSA:

The role a Chief Scientific Adviser was not to tell government what they should be doing, because I had no democratic mandate, whereas the politicians were elected... A Chief Scientific Adviser can be asked by ministers: "what would you do?" or "what would you recommend?" and, you know, you can recommend what you think according to the evidence, but you should never be in a position - nor did I ever want to be in a position - where you are saying: "you must do this". That's not the role... The scientific adviser's job is to take all [the] discussion, the uncertainty, and to be able to present it to policymakers and politicians in a way that they can do something sensible with it... A scientific adviser could be - [although] it is less usual - involved in helping to define the options, but I would say that I do not think a Chief Scientific Adviser should be instrumental in deciding which option is the best. There might be a combination of options used... So, you need to be very mindful of where you stop giving advice.

In all cases, interviewees were underlining where science advice ends and where political decision-making begins. Determining where that boundary lies is often an iterative process and one of the most important aspects of advisers' learning (see Chapter 8). The other boundary being drawing here is between what should and should not be communicated. In the Science Arbiter model, the science adviser only communicates answers to policy questions 'that can be resolved by science' (Pielke, 2007, p. 16), whereas in the case of the Honest Broker of Policy Alternatives, the science adviser seeks to act as an integrator of both scientific knowledge and non-scientific concerns. In both cases, there is some translation work involved.

Reflecting on their experience as a specialist adviser to select committees in both Houses of Parliament, one experienced adviser described their role as 'a broker of information and helping to translate information for MPs and Members of the Lords'. And as another would suggest to their younger self, the honest broker role involves being 'an integrator and synthesiser even if you have a deep specialisation... and try to explain - in the simplest terms - what it is you're doing and why you're doing it'. With regards to their experience in a parliamentary organisation, a former intern told me that learning to 'synthesise a lot of

information, familiarise yourself with it very quickly, and then make it into very sort of simple, clear English was a very useful skill’.

Interviewees also spoke of the responsibility of science advisers to ‘take complexity and simplify it’. In fact, one of them advanced that policymakers are going to go ‘nowhere if they think they have to deal with that complexity at every stage’. One strategy is to provide policymakers with some ‘good proxies’ and explain how they might help, as one experienced adviser suggested. Another argued that it boils down to ‘crafting the language’ in a way that helps policymakers make sense of the complexity of wicked problems. One of my interviewees put it very plainly: ‘you have to be able to [articulate] really quite simple [and] very accessible messages’. Two former CSAs pointed out that this was a skill that most academics already possessed and not dissimilar to ‘putting together undergraduate lecture courses’. A similar sentiment seemed to be confirmed by a couple of former interns who had the opportunity to deliver presentations on the work they were doing and did not find them particularly challenging to execute.

When it comes to communication to non-academic audiences, translation and writing requires tact and practice. For an experienced adviser who worked on GMO advice, although the science was clear to the advisers, it took a lot of work to ‘translate’ the message in a way that the public could accept and understand. Their takeaway from that experience was that the way not to go about it is with an arrogant tone or with the deficit model in mind. The sheer amount of effort and learning involved came through strongly in the success story of another experienced adviser:

[The language we used] became part of the machinery of government, the language of government. We did something right. I mean *I suppose I’d learnt enough by then*. Sitting down and *redrafting the entire report took me 6 weeks* out of my life to do that, which is interesting. I did nothing else, *I worked 6 days a week for 6 weeks to redraft the report*. As I’ve said to people many times: “I’ve never read it, I just wrote it” <h>. I never read it, I just [tried to] make [it into] a positive message. Keep it simple, assemble the evidence, but don’t baffle with unnecessary [jargon]. Keep it honest, keep it simple, keep it positive. And, you know, there’s plenty of positive things about climate change [or rather] plenty of positive things to do (emphasis mine).

6.2.3 Science advice is about managerial skills

The third skill profile was far more subtle to tease out. Here, my interviewees did not necessarily mention managerial skills per se, but instead related their experience in science management or policy for science to their work in science advice. The importance of these skills became all the more evident in my ethnography of Defra SAC, which acts as a high-level

strategic committee. From the meetings I observed and my follow-up interviews with members, I gathered that their role is more akin to *management consultants* than to science advisers on more technical advisory committees. I will further discuss my ethnography of Defra SAC in Chapter 7. Interviewees deployed a number of metaphors in describing this aspect of their role. One of the former CSAs, for example, equated the role of CSA to an editor-in-chief of a peer-reviewed journal:

It's not like writing a paper for a scientific journal, it's not like being a referee, it's like being an editor-in-chief for a broad spectrum journal where stuff comes in - a paper comes in, or an issue arises in the department - and it's your job to work out who the reviewers are, who the experts are in this area. If there's a disagreement between the reviewers of a paper, for a journal say, if there's an issue about whether you know this, that, or the other, ...how do you organise peer review? How do you generate a kind of idea of what's going on in what may be a contested and uncertain area? And I think that's the scientific thing, you know. So, it's not the science of X, or Y, or Z, it's that one's experience in academia, and the refereeing papers in journal, organising conferences, the whole management process of academia, has you used to this.

Another former CSA suggested that the experience of being a vice-chancellor or pro-vice-chancellor of a university, or leading a large research group⁵⁷, equips you with an understanding of 'how to make change happen' and 'that's a big part of it, because advice without understanding it is just not going to go anywhere'. And interviewees confirmed that advisers sometimes find themselves advising on policy design, organisational structures (of science advice for example), and/or institutional reform. This sort of advice undeniably falls under the umbrella of what Weinberg (1972) called 'trans-science' or 'trans-scientific' issues; 'questions which can be asked of science and yet which cannot be answered by science' (p. 209). These various managerial skills are now deeply embedded into the organisation of science, as one of my interviewees suggested.

These sorts of leadership skills were also absolutely fundamental to good Chairing, which I come back to in Chapter 7. Alongside the various leadership and managerial toolkits that experienced advisers spoke about developing within science, they mentioned the importance of interpersonal skills in engaging and convening stakeholders of different sorts. This was certainly the case for CSAs who act as both leaders and convenors within their respective departments and broader networks. A former CSA talked about their role involving 'bringing

⁵⁷ An experienced adviser told me they 'learned a huge amount' in one of their managerial roles. They said it was 'a huge opportunity to learn, to engage at different levels [in] academia, science organisations, and politically'. They also learned 'the importance of behaviour and the importance of adoption, and how difficult that is actually'.

people from broad areas of science together’ and engaging ‘very widely’. Another highlighted that learning ‘to bring those different communities together and get them to understand each other... is one of the key things in being a good scientific adviser’. As another former CSA put it:

It is the ability to simultaneously work with the Ministers, gain their trust, work with the senior civil servants, gain their trust, work the junior civil servants because they’re the ones who are doing the day-to-day work that feeds up the system, and work with the science community in the universities, work with the other funding agencies like the research councils, ...but then also work with some of the end users.

For advisory committees, the degree of convening and stakeholder engagement required can vary. One interviewee pointed to the UK Committee on Climate Change’s (CCC) mandate to interact with stakeholders beyond the government, for example. One experienced adviser posited that academics coming from some academic disciplines might be better prepared for this convening role - claiming that their own engineering training and work experience taught them how to convene stakeholders ‘from different disciplines in a way that allows them to be very creative’. They also added that the ‘general principles’ and ‘set of tools’ for doing that in engineering circles are largely portable to the ‘policy environment’. Convening, then, seems to require a combination of hard skills in facilitation and soft people skills. I present other soft skills in Section 6.3 and I return to the influence of disciplinary training on skills in Section 6.4.

6.2.4 Science advice is about political acumen

The final - and perhaps most intangible - skillset emerging from my interviews revolved around the importance of political flair or acumen. If that is indeed a learnable skill, it should also be recognised that it is largely tacit. I will therefore only endeavour to provide a few examples of what it might encompass and why it is so important. One of the advisory roles where ‘big-P’ politics is on full display is as a specialist adviser to parliamentary select committees. One experienced adviser told me that these environments are ‘entirely political’, which means that ‘there is a view as to what the answer ought to be before they even start these inquiries. So, if you’re going to come up with something completely different, you’re going to be on quite a difficult position’. They highlighted that specialist advisers have to ‘learn how to balance the language’ and to navigate that political landscape.

In these highly political arenas, tact and an appreciation of political values can go a long way. If advisers instead display political naivety, they can fall on deaf ears or even lose face. For one experienced adviser, this was blatantly the case with Professor David Nutt, who famously compared the dangers of ecstasy with horse riding and essentially accused the politicians of

being irrational and 'silly' for not following the evidence when it comes to UK drugs policy. This interviewee illustrated the absurdity of Nutt's remarks by saying that 'we haven't set a policy which says that we work out what's legal and what's illegal by the death rate'.

My interviewees broadly agreed that respect for one's audience and their sources of information was a key part of being a skilful adviser. And that applies to the 'many voices... competing for the ears of politicians' including 'voices of interests', as one described it. These voices can include NGOs who also seek to 'deliver to a particular constituency and so they're political as well', as one interviewee pointed out. Similarly, a former intern came to appreciate through their placement that learned societies can also act as interest groups - protecting academics' interests and making sure they get a say or are aware of opportunities to influence policy. Another was quite surprised by the variety of stakeholders and interest group representatives at a policy workshop they attended, and was particularly intrigued by how the academics and civil servants interacted with those stakeholders (some of them very skilfully).

According to one experienced adviser, working with individuals coming from industry - in an advisory context - can (if done properly) be largely positive. They recounted a time where success in such a collaboration was 'greatly to the credit of some particular individuals from those other interests [who] managed to play the ball, not the man'. Their takeaway from this experience (and others) was that this sort of constant political 'turbulence' in advisory settings does not mean that you cannot get your message across as an adviser; one just has to be explicit and upfront about the political biases.

6.3 The character traits of a skilful adviser

In the following section, I focus on the character traits that my interviewees identified as must haves, in that they are valued both by peers and by the audience of the advice. In that sense, they are *boundary spanning*. These soft skills or traits might chiefly be a matter of personality (nature), but they can also be learned and strengthened (nurture). And a discussion of these traits is important for at least two reasons: i) possessing such traits makes an adviser's learning journey smoother and hence perhaps less transformative; ii) developing them increases the chances of further invitations to advise and impact. I however do not attempt to draw the line between traits that are largely innate and those that are largely acquired, because such a task is both empirically infeasible and very much beyond the scope of this thesis. Instead, I have identified three character traits that encompass most of the desirable qualities highlighted by my interviewees and - in the paragraphs that ensue - I seek only to redefine them in the context of science advice and to elaborate on their importance. In Table

5, I go on a bit of a conjecture and attempt to summarise which traits are most helpful and which ones are not (largely based on the data, but also on my personal observations).

The first prominent trait that was mentioned by both experienced advisers and former interns was *adaptability*. Above all and in general, adaptability is a character trait that greatly helps advisers adjust to the (foreign) policy culture. While not quite adaptability per se, *cross-cultural adaptation* is a recognised and widespread concept in the behavioural sciences. It 'refers to the process of internal change in individuals so as to be able to function in an unfamiliar culture. Newcomers learn to make adjustments in their original cultural habits and are able to attain a level of efficacy in the new environment' (Kim, 2012, p. 623). For one experienced adviser, adaptability involves the ability and desire to learn on the fly. In the context of science advice, adaptability has various connotations and differs from flexibility, which might imply a willingness to compromise on some normative positions or on scientific rigour, for example. My interviewees were very clear about this distinction, albeit not in those exact words. In the way interviewees employed it, it was suggestive of the ease with which a person can calibrate their language and behaviour, collaborate with people who have divergent worldviews, and look for solutions within a different paradigm than one's own. As one former intern put it, you have to be a 'chameleon' in science-policy. They observed varying levels of skill there, telling me that it was 'definitely something that would take practice or serious thought and consideration. It's not just a thing that happens; you have to cultivate that'.

For an experienced adviser, adaptability had a more specific meaning, namely being open-minded to emerging career opportunities. They lamented the obsession with perfect CVs. Echoing that point, another experienced adviser said that their 'career took strange directions' and 'it wasn't a career I ever really chose, I just adapted to what happened'. Yet another experienced adviser mentioned they had read about how with the 'biographies of successful people it always looks like there was a planned trajectory, ...whereas actually when they lived their lives it was very random' and that they recognised their own career trajectory as having been very random. In many ways, by being adaptable and open-minded, advisers make their own luck (referring back to Section 6.1.3).

The second prominent trait has already come up in various places and combines active listening with empathy: *empathic listening*. As I argued previously, there is no doubt that being a good communicator is a key asset for science advisers, but so is the capacity to listen, empathise, reflect, and ask constructive questions. They are of course related and both sides

- i.e. empathically communicating and listening - help with learning about and learning to appreciate a foreign culture. The importance of empathy was best illustrated by the capacity of one of my interviewees to get along with a Prime Minister who had the exact opposite political ideals to theirs. Being more empathic was also the main advice one experienced adviser would have given their younger self:

I think what I would say is: "the more [you] kind of develop listening skills and empathy - if I can call that a skill - but [at the very least] capacities to be empathetic for other people [and] for other living things, and to understand people's kind of circumstances, [the better]".

Another aspect of empathy is patience, which one experienced adviser said was crucial to get on policymakers' 'B list'. They added that a display of patience, humility, and empathy can make you stand out amongst 'arrogant subject matter experts... [who've] been active for a while'. In terms of active listening, another insisted that for them 'the most important thing a science adviser can do is the ability to ask questions'. It was also apparent that a majority of my interviewees were quite curious people. For example, one former intern said they very much enjoyed the chance to 'dip into a range of different analytical or conceptual areas' in their internship. That sort of curiosity most likely also contributes to active listening. An indication that active listening can largely be learnt was given by an experienced adviser who would have told their younger self to 'listen a bit more' and 'be a little more reflective'. A former intern said that 'probably the people who are best at this are the people who had the most practice <h>'.</h>

The third prominent trait, *self-assurance*, connects with earlier discussions on the importance of gaining experience before engaging in policy work (covered in Section 6.1.1). According to the Collins online dictionary (2022), 'someone who has self-assurance shows confidence in the things that they say and do because they are sure of their abilities'. Self-assurance in a science advisory context might then revolve around the confidence in one's advice or recommendations. As many interviewees pointed out, self-assurance does not however imply certainty; instead, an adviser's self-assurance is also the confidence they have in the limits of their advice - the uncertainties, the known unknowns - and in communicating them to policymakers. Hence, self-assurance needs to be accompanied by honesty and humility, two traits often mentioned by interviewees with regards to communicating uncertainties. If you are confident in your knowledge and/or recommendations, part of self-assurance is your ability to defend them regardless of the seniority of the interlocutor. To quote one former CSA:

You've also got to have a fair amount of, I don't know, I suppose self-confidence is overstating it, but you've got to be able to go in and be prepared to contradict very senior people, including

politicians if they are saying something that's wrong... It depends [on] how you do it. If you interrupt the Prime Minister and say: "you're talking complete rubbish, Prime Minister", you're going to have a relatively short career <h>. On the other hand, if you say: "it's an interesting point of view, but there is a lot of evidence against that particular point of view", you keep going <h>.

Self-assurance also helps with perseverance, which some interviewees said you need a lot of to not get discouraged in science advice. Self-assurance and perseverance can be aided by a positive mindset or optimism. For instance, a couple of the experienced advisers said they were quite optimistic people and that it helped. One of them told me: 'I have a disposition to be slightly positive. Inside I'm an angry [person]. We are messing with the world. It's utterly dangerous. But I also have a general disposition to be positive'. Finally, self-assurance is not just about oneself but also about trust in the system at large. Advisers need to have confidence in the advisory system's capacity to reach evidence-informed options that policymakers may (or may not) pursue and to continuously improve. Trust in the system is almost a prerequisite for building confidence in one's individual ability within it.

One experienced adviser suggested that self-assurance is not necessarily innate and can be built over time. They recounted how - as a shy person - the best piece of advice they had received was from a more experienced peer who had told them to always speak up even if it was to say 'naive things along the way', because 'sometimes the naive things need to be said', and sometimes they might not even be naive after all. With time, less experienced advisers can learn to surmount their fears and imposter syndrome - which a couple of my former interns claimed to have. Perhaps to a greater degree than the previous two traits, self-assurance is intimately tied to experience and, ergo, to learning.

Table 5: Summary table of the desirable and undesirable traits and skills

Traits that help	Traits that do not help
✓ Adaptable ✓ Dependable ✓ Discrete ✓ Humble ✓ Interested ✓ Open-minded ✓ Optimistic ✓ Patient ✓ Pragmatic ✓ Self-assured • Empathic • Honest • Perseverant • Reflexive	× Rigid × Erratic × Gossipy × Arrogant × Dismissive × Dogmatic × Cynical × Impatient × Idealistic × Insecure • Overly critical • Patronising • Pedantic
Skills that are valued	Skills that are not valued
• Asking incisive questions • Big-picture/systems thinking • Communication skills • Evidence synthesis • Interpersonal skills • Leadership skills • Political acumen • Reviewing skills	• Academic meticulousness • Academic writing • Critical or radical thinking • Political campaigning • Theoretical thinking • Ultra-specialisation

6.4 The influence of academic disciplines

In addition to one of my interviewees' point about engineering and convening, which I mentioned in Section 6.2.3, interviewees described how particular disciplines or academic paradigms had equipped them and/or given them an advantage in science advice. One suggested that ecologists were potentially better positioned to broker than other disciplines because of their systems thinking, saying that the 'NERC community were better brokers than the agriculture community' because agricultural research had become increasingly narrow and reductionist in recent decades. Another made a very similar point by highlighting that 'ecological understanding' is helpful for understanding policy, although there is still a lot of learning involved. Unsurprisingly, the economist I interviewed argued that the discipline lends itself to be policy relevant because it 'provides the framework and the grammar to discuss the things that affect the economy, which is pretty much everything'. Finally, an interviewee trained as a biologist reflected on the fact that their disciplinary training had helped them with

policy because 'biology is messy' like the social world, and because systems thinking is possibly the 'world's most transferable skill'. The latter sentiment was shared by a number of interviews who saw systems thinking as an important asset in science advice and especially in dealing with wicked problems.

It was not entirely clear if interviewees agreed on whether or not it was more useful to come from a more applied than blue skies research background, despite most of them coming from quite applied disciplines and/or research environments. At one end of the spectrum, an experienced adviser claimed that their work would not be of 'much use unless it gets applied and in many cases the applications are in the hands of the government'. At the other end of the spectrum, was a social scientist who said that having 'quite a theoretical approach' had 'given [them] a way of conceptualising an insight to problems that is quite useful'. But there is nevertheless a bit of a chicken and egg problem here, that one of my interviewees spelled out. They expressed doubt about whether correlations between advisory work and applied science were due to the disciplinary training itself or, rather, due to the sorts of people attracted to applied research at the outset:

I think it's a reasonable proposition to say that those who have worked... on kind of real-world problems, as it were, rather than you know theoretical kind of understandings... perhaps you'd expect a kind of pure mathematician or physicist dealing with quantum theory to be less able to get across some of those things because of the nature of their research, but equally it could be that those are the kind of people that go into that sort of work in the first place, you know I'm not quite sure where the causality lies (experienced adviser).

As a case in point, a couple of interviewees pointed out how some mathematicians were absolutely incapable of policy work, whilst others excelled at using their mathematical training in an advisory capacity.

6.5 Are skilful advisers T-shaped?

Arguably one of the most important findings in my data is that most of the experienced advisers I interviewed could be characterised as *T-shaped*. A broad definition of the T-shape would be: deep subject matter expertise (the vertical bar) combined with a capacity to work and collaborate across a wider range of domains (the horizontal bar). According to its Wikipedia article and one of my interviewees, the T-shape metaphor was popular in recruitment circles in the 1980s and 1990s. In academic career terms, the T-shaped career might often involve working in a narrow field of research in the years immediately following a PhD, before undertaking work within interdisciplinary projects and/or outside of academia. As one experienced adviser explained:

Traditionally, [what] many people have done is to have what is often called a T-shaped career, where... you start off essentially heads down and you get real expertise in one particular area, and then later on one tends to sort of branch out. And I guess that's my trajectory and it's a trajectory of a lot of other people that I know that are quite active in science-policy.

Not all of the experienced advisers mentioned the T-shape metaphor directly, despite many of them hinting at the importance of it under different guises. Interestingly, it was Defra SAC members who mentioned the T-Shape more often than the unaffiliated experienced advisers - perhaps testifying to the exceptional interdisciplinarity and broad remit of the committee (more on that in Chapter 7). Insofar as a large majority of the experienced advisers I interviewed considered themselves to be interdisciplinary and/or had engaged in numerous interdisciplinary activities, there were strong signals that being interdisciplinary helped with being a skilful adviser. This seemed to be instinctive for less experienced advisers too: a former intern told me that having an interdisciplinary background equips you to talk across worlds and that they had witnessed how those with a narrow perspective really struggle to do that, on different committees. One experienced adviser contended that 'one needs a fairly broad understanding of science', while another said that one needs to be 'solidly grounded in one area but at the same time be broad enough'. A former CSA would advise their younger self to 'always stretch yourself' and 'always be slightly outside of your comfort zone'. In the words of another interviewee:

When you get to a point where you know what you need to know, you need to move onto another field and... you've got to have this desire to learn. You've got to have a desire and interest in exploring other areas and... you've got to be able to read and interrogate at the appropriate level, because if you try and get into too much depth in these other areas, then you can't become that T-person.

However, rather than dismissing deep specialisation as undesirable, experienced advisers unanimously defended its importance, with one asserting that you still have to be 'an expert in your own -ology to get anywhere in science'. A couple of my interviewees also cautioned against branching out too early in a career, echoing comments on the importance of building up experience before doing advisory work (see Section 6.1.1). They recommended that the in-depth specialisation phase is fundamental, with one of them advising their younger self to 'do the apprenticeship, show you can cut it as a scientist, and then you're more likely to be trusted if you don't extend too far away from your area'. And, according to another:

I think the T approach is about that listening and reflective thinking that you have to do when you're in an environment where there's a lot of people with depth knowledge. And also, recognising the essential role of the depth knowledge; you can't sit there thinking: "well, it's irrelevant to the

question we are trying to answer”, because that depth knowledge is really important. So, I agree that [the T-shape] is important, [but I also] do have depth knowledge.

What seemed perhaps most important to my interviewees with regards to the T-shape was not so much the breadth or depth of knowledge, but rather the soft skills needed to work with - and learn from - other subject matter experts. As Freeth and Caniglia (2019) underline, interdisciplinarity is not just about cognitive skills but equally about collaboration skills. One natural scientist highlighted the importance of understanding other disciplinary worldviews and particularly those in social science; saying to their younger self that ‘social scientists think very differently from natural social scientists. You’ve got to be able to understand the different thought processes in different disciplines basically’. Another natural scientist told me that they learned ‘massively through working alongside social scientists’. Conversely, one of the experienced advisers recounted that one of their first academic jobs was in a scientific environment where they were the only social scientist. They claimed that the experience had taught them to communicate much more clearly and concisely, and helped a lot with subsequent appointments in science advice. Across my interviews, these sorts of parallels between the skilful interdisciplinary researcher and the skilful adviser were often subtle but nevertheless commonplace.

While arguments that interdisciplinarity can better equip researchers to address complex societal problems and work in non-academic environments are well established (e.g. Wowk et al., 2017), it is less clear whether interdisciplinary research, itself, transforms and prepares academics for science advice or whether individuals inclined to do interdisciplinary research are also likely to be skilful advisers. Unfortunately, studies on the relationship between character traits and the propensity to undertake interdisciplinary research are sparse. In their study, Katoh et al (2021) found that ‘extraversion’ and ‘conscientiousness’ appeared to be associated with the pursuit of interdisciplinary collaborations. They however did not find any conclusive correlations between personality traits and other forms of collaboration such as collaboration with industry or government. Encouragingly for the hypothesis that the qualities in interdisciplinary research are somewhat portable to science advice, there is nonetheless some resonance between the two personality traits identified by Katoh et al (2021) and the traits I discussed in Section 6.3. In sum, despite some indications that predispositions to do well in interdisciplinary research environments are likely to have similar effects in science advisory contexts, the chicken and egg conundrum regrettably remains largely unresolved.

7 Modes, models, and institutions of science advice

In the previous two chapters, I discussed the macro and micro levels of science advisers' learning. The macro level includes both the professional cultures and national cultures within which advisers operate. The micro level relates to their personal experiences, skillsets, and idiosyncrasies. This chapter brings the meso level into view - taking as objects of study the UK ecosystem of science advice in its totality and three of its institutions with different philosophies, functions, and remits. Through a combination of both interview and ethnographic data, I present the different ways research participants conceptualised and performed science advice. I begin with an assessment of the diversity of models of science advice in the UK and associated learning experiences. I then present the analysis of my three sites of study: i) the Defra Science Advisory Council (SAC), ii) the Hazardous Substances Advisory Committee (HSAC), and iii) the Centre for Science and Policy (CSaP). This chapter is organised in four parts.

In the first part, I provide an overview of the various models and modes⁵⁸ of science advice offered by all of my interviewees. Instances of situated and transformative learning - and the ways in which they vary with the models of science advice - are highlighted throughout. In the second part, I give a short overview of the concepts of *organisational culture* and *institutional epistemology* (see Borie et al., 2021). In the third part, I present my analysis of the three aforementioned case studies, focusing on their respective organisational cultures, institutional epistemologies, and their impact on members' learning. In the fourth and final part, I draw on all of the above to derive two high-level models of science advice with markedly different effects on advisers' learning outcomes.

7.1 The different kinds of science advice in the UK

It became clear from my interviews and from ethnographic observations that there are many different ways in which science advice is organised and carried out. In this section, I focus on my interviewees' different conceptualisations of what science advice entails. These views largely depend on the position of the observer in the science advice ecosystem. And while the ecosystem itself is obviously constituted of all the modes of science advice I discuss below, it is rare for a single adviser to have experienced all of them. Advisers' learning is therefore constrained and shaped by those models of science advice to which they have been exposed. I will substantiate that point in Section 7.4.

⁵⁸ I see models as connoting largely conscious and deliberate system design, whereas I see modes as connoting behaviours, habits, and manners of doing - which can be more unconscious or emergent.

7.1.1 Science advice is not advocacy

I found that questions around advice versus advocacy often irritated interviewees and were too leading for the nondirective interview style I was aiming for. So, whilst I did not consistently probe interviewees on that distinction, the few who commented on it and/or spontaneously brought it up had strong opinions about it. Some actively drew a boundary between advocacy and advice, seeing advocacy as immutable and outcome driven, and therefore as incompatible with the *adaptability* needed in science advice. To quote one experienced adviser who worked on GMO issues:

As [a form of] engagement, [science advice] is not framed as [being] persuasive [with regards to] a particular hard view that you don't want to change... If you are going to get into that space, you have to be ready for being able to respond to the circumstances and views of a whole range of different people and including those who are not going to agree.

Others saw it as more of a balancing act:

[You have to] toe the line in the middle and not... stray too much in the kind of advocacy direction or any one direction... [I'm aware of] workshops [and] talks in various academic conferences - or in general - about how to balance advocacy with being a scientist... It's a delicate balance between being a scientist providing advice or even just information and then advocating for something like an environmental movement, and how you can reconcile those (former intern).

Interviewees provided some examples of science advice that successfully avoided advocacy. An experienced adviser praised a book which presents the maths of different climate policy options, saying that 'it's one of the best things... from a policy [perspective], because it doesn't do advocacy'. A former CSA argued that reports from the Intergovernmental Panel on Climate Change (IPCC) are good examples of making information accessible through a 'large degree of word crafting' without falling into advocacy. A former member of the RCEP told me that the Commission could be 'quite punchy in its recommendations' and 'quite critical of government', but those recommendations were 'based on argument as much as possible'. They contrasted the work of the RCEP with campaigns from environmental NGOs, which they said were based on beliefs and values as a starting point, rather than considered arguments and evidence⁵⁹.

However, advocacy need not take the form of issue advocacy or even 'stealth issue advocacy' (Pielke, 2007). Instead, as one former intern observed, advocacy can happen within the realm of science and can transpire in a science advisory context. They recalled witnessing 'people [who] want[ed] to solve the same problem but [had] slightly different approaches for it, and

⁵⁹ Another form of boundary work around the fact/value distinction.

there are different frameworks with different names, and then people [got] possessive over their own framework... it's a minefield'. More strikingly, a former CSA affirmed that they were pleased with how they had managed to 'push an agenda' on particular issues they thought the government was not taking seriously enough. Rather than pushing for specific policy options, they were working on redirecting the government's gaze towards particular (scientific) issues. This is similar to trying to influence research agendas or applying for funding in the science world, a perfectly normal and depoliticised form of advocacy from scientists' perspective. That is perhaps where most scientists would draw the line or establish a boundary between acceptable and unacceptable advocacy. There was no clear evidence of learning amongst my interviewees regarding this particular distinction or form of boundary work.

7.1.2 Science advice is formal and informal

As I discussed in the previous chapter, the experienced advisers I interviewed (across the board) came in through various formal and informal channels. Most of them nevertheless described the ecosystem as having a combination of both informal and formal structures and activities, with some of them spontaneously categorising their advisory experiences as formal or informal activities and/or offering views on the relative advantages and disadvantages of both. Commenting on the advantages of formal advisory committees - compared to more ad hoc, informal advice - an experienced adviser said:

There is continuity, so you don't have to start from scratch every time... There's a learning process to these advisory groups, and if you have new members that come all the time, then you have to start all over [again] all the time... There's [also] a good basis of [mutual] understanding, both for the people sitting in committees and the people receiving the advice... There's trust. Even if the governments might not agree with the advice, they might [try to accommodate it]... And there's a balance between the various actors in society, so, there's government, there's NGOs, there's businesses. And then these advisory committees sort of fend for one corner in a way and they occupy a space that is really rather unique. I certainly have seen [that in the context of this very young committee]. There's lots of different bodies and entities and everything. And it's very chaotic and there's a lot of different voices coming from different places. And I think that this advisory committee has sort of been able to solidify [things] a little bit. Or at least provide a kind of neutral space for discussion [within the ecosystem] perhaps' (emphasis mine).

Conversely, according to another experienced adviser who worked with Defra, despite having 'almost thirty committees that you could call... science advisory or evidence advisory committees', the most important aspect of advice in Defra was relationship-building, 'and that often comes at more of a personal level'. For example, two former CSAs spoke about having weekly CSA breakfast meetings, chaired by the GCSA. One recounted just how valuable those

meetings were for understanding issues and sharing information across Ministries. Another said it was like a 'real club in a good sense', helping to develop 'a degree of camaraderie' amongst the CSAs. As one experienced adviser put it: 'in general, some of the most important discussions took place in the pub after a committee meeting, rather than in the meeting itself'. Contrastingly, a former CSA said:

[The conversations] wouldn't happen over a drink in the pub because this business about confidentiality is very seriously treated, but they might happen... in a private room with a drink. If you're at a reception or something. And yes, an awful lot of the informal making of the wheels work happens at those receptions and there are quite a lot of those. There are a lot of government receptions... and you'd find a collection of civil servants. So, the interactions between, for example, the different Chief Scientific Advisers, [and] civil servants in different Departments, will often [happen] informally [at] those sorts of things.

Former interns also spoke about the importance of informal interactions. To quote one:

Those off-hand conversations [are crucial]. I went out for dinner with my team a few times. Those [occasions] were really important because everyone is just a bit more loosened up, I think... So, I'd say yeah, definitely, being able to communicate my research and follow up straight after was probably the most impactful opportunity [I had during my internship]. But [also] the conversations making coffee in the kitchen were brilliant. I remember a few of those quite well... [For example,] they'd just ask me for a quick summary or [opinion]: "what do you think we should do?". And you're like: "oh god, I've been waiting for this moment for three years" <h>. So, yeah. It's definitely a mix, but I think part of that is based on building these relationships so that [you are then in a position to have] the odd conversation with people while you make coffee.

Notice how the interviewees who spoke about informal advice also spoke of sociomaterial spaces. The implication is not that the physical location of advisory committees (and their secretariats) does not matter (see Owens, 2015 for example), but rather that - in the minds of advisers - informality is associated with certain sociomaterial spaces. Whether it is the pub, a restaurant, a cafeteria, or the office kitchen, each space offers different opportunities for exchange - expanding or restricting the possible levels of informality and intimacy. When it comes to learning, we might expect that learning outcomes vary depending on the adviser's exposure to formal and/or informal activities. The perceived independence of science advice - or the importance given to building individual relationships - might differ between an adviser who has predominantly been exposed to informal settings and one who has mostly done committee work. I elaborate on these various points further in Section 7.4.

7.1.3 Science advice is proactive and reactive

Another contrast that came up in the interviews was between science advice that is *proactive* (e.g. horizon scanning) and science advice that is *reactive* (e.g. answering specific questions or responding to requests for input). The clearest illustration of this contrast came from a former CSA who said:

There is a variety of different types of scientific advice that can either be asked for. In other words, the scientific adviser [can be] reactive to a request, for example in Foresight, [or] in some other areas, a Chief Scientific Adviser might be proactive because they're aware of innovations or new science that is being developed and it may likely have policy implications down the line. And so, you would raise that.

It is tempting to think that proactive and reactive can be replaced by 'unsolicited' and 'solicited', but that parallel does not quite hold. While solicited advice is largely synonymous with reactive advice (e.g. parliamentary calls for evidence), proactive advice might still be solicited to the extent that an advisory committee or a group in GO Science get asked - or are given the green light - to work on a report or horizon scanning exercise, for example. Besides, unsolicited advice can have negative connotations that proactive advice does not have. As one experienced adviser put it: unsolicited advice is mostly 'just information made available to policymakers'. And as another experienced adviser argued, unsolicited advice can be naïve and unhelpful:

Bad advice is in essence naive advice. There are numerous types of bad advice. There is one where we, as academics, go away and do our research and then just lecture poor bloody policymakers about what we have done. And that might be a sort of push from us... Occasionally policymakers [do] need to know what's happening at the coal face of research, but normally that's not something that helps them directly. So, [a] much better [strategy] is [to] pull from the policymakers; [to ask the question:] what is the evidence base that is relevant to decisions that they have to make?

As illustrated in the quote above, proactive advice can involve a lot of seeking context and relationship management. It can be effective in many ways - including preparing the grounds, raising issues not previously on the political radar, and/or offering a vocabulary to policymakers (and other interested parties) to make a case for reform. Especially if these contributions come early on in the policy cycle, they can have greater effects than reactive advice, which will more often come further down the line (e.g. as quality assurance on existing proposals).

Another possible distinction is between supply-driven and demand-driven advice. This distinction is closer to reactive and proactive advice - as it highlights which side is largely in

control of the scope of the advice - but, in a demand-driven advisory setting, advisers can still be proactive. For example, a specialist adviser to a parliamentary select committee told me:

My job [was] to find the right questions to put out into evidence calls and to find people [to] respond, but *you also want to be proactive* in making sure that good subject matter experts respond. So, part of my job is to work with the clerk and actually email the call for evidence to a particular individual and say: "Professor so and so, we really would welcome it if you could find a couple of pages to send to us on this, because we know that you know about this". So, it's very active evidence gathering. The framing of questions is of the upmost importance (emphasis mine).

In a similar vein, the former interns who worked in a parliamentary context described their experience as a mix of proactive and reactive work. Yet, they also stressed that reactive work - such as answering enquiries from MPs - nearly always took precedence; mid- to longer-term proactive research would generally have lower priority. The short-termism of the party political and policy cultures would play out daily for these interns, and more so than for those interns who mostly prepared evidence statements or were assigned to research projects. That is another hint of how the advisers' learning may vary with the environment and model (or mode) of science advice.

All in all, the distinction between proactive and reactive advice boils down to: i) the degrees of freedom that advisers have in scoping their advice and/or in determining the workplan in the cases of committees and ii) the level of passivity⁶⁰ they choose or are constrained to adopt. Within that framework, advice can be solicited, unsolicited, supply-driven or demand-driven. As I will be demonstrating in the cases of Defra SAC, HSAC, and CSaP, different committees or advisory organisations may adopt different combinations of the above. Nor are these categories static; the extent to which advice is proactive or reactive - at a given time - will also depend on the (political) context of that advice. In the case of emergencies, science advice tends to be primarily reactive (Wilsdon, 2014). Indeed, reactive advice is the foundational design principle of the Scientific Advisory Group for Emergencies (SAGE). An experienced adviser also described how a committee they sat on - which was ordinarily 'incremental, in the background' - could be forced into a reactive mode when a particular controversy put them under the political and mediatic limelight. The main point is that although these modes of advising are fluid, they are not necessarily interchangeable.

⁶⁰ I endorse Moore's (2017) distinction between 'passivity in the dimension of judgment' and 'passivity in participation' (p. 7). For Moore (2017) one can choose to be passive by not fully participating in a process (by default), while still judging - or forming an opinion - and retaining the option to actively participate or contest. In the case of science advice, difference levels of passivity might be warranted depending on the mode and context of interaction.

7.1.4 Science advice is about collaborative writing

Experienced advisers - especially those who have mostly been exposed to committee work - underlined the importance of reports and documents in science advice. In this mode, science advice is essentially an exercise in collective writing, which is very much akin to writing academics papers with multiple authors. This aspect of advising involves research and communication skills, as laid out in the previous chapter. Just like academic papers, science advice reports often put forward nuanced arguments and have been through multiple stages of editing. Most of the time, science advice reports are more like literature reviews than original research articles; they usually seek to synthesise large swathes of academic literature and translate the essential points into language that is both accessible and policy relevant. Both experienced advisers and former interns who worked on evidence statements suggested that writing these reports is an art that requires some practice and learning. To be effective or influential, they claimed that academic norms could be unhelpful and often needed to be set aside. Learning to write these reports in a policy-friendly way was a transformative journey for some, with a couple of former interns claiming that their own academic writing had changed as a result.

Reports leave a paper trail and are the clearest embodiment of the approved and legitimised position of an organisation (often dissimulating the conflicting or diversity of views within) (see Borie et al., 2021). In the case of some committees, such as the CCC, the government is obligated to respond to such reports. Finally, reports are also perceived as the main and most public-facing products of science advice. But it is not just reports that attract attention. Meeting minutes were highly mediatised and at the centre of critiques of the secrecy of SAGE by many commentators in the early stages of the COVID-19 pandemic (Baker, 2020; Costello, 2020; O'Carroll, 2020). The fact that they were not being published was seen by many as a sign of the culture of secrecy in SAGE and in government. Sir Patrick Vallance eventually mandated that the minutes be published, even though they were to be edited and approved by government beforehand.

One experienced adviser who was particularly articulate about the benefits of reports, suggested that the 'IPCC is really like the perfect kind of assessment... and so everything else is downhill from there'. They added that government reports are 'also very good', but 'mostly very focused on answering questions'. Overall, they saw reports as a structuring device and framework which can help advisers with the process of 'reaching consensus' and building trust:

I think reports are critical, because first they allow the people who write the report to formally put their thoughts together. It's like a framework for your own recommendations. So, [for] the people who put recommendations up, there is a process to this... and then at some point the recommendations sort of bubble up. So it's not a top-down [process]... Very often recommendations become very obvious when you've done the right amount of work. And so, reports do that to the people who are in the committee... You are able to explain why you have come to that recommendation. So, you have a path behind you. And this is very important, and I have found that if I'm able to both give my recommendation and explain why my recommendation is what it is, then I gain a lot of trust from the people who I talk to. And the fact that they are able to then go and look at my recommendation, even adds to that trust. Even though I have to say that I'm pretty sure very few people go back and check. But the fact [is] that it is there [and] sort of enhances the whole feeling of being reliable. So, you have nothing to hide.

Framed this way, reports can be seen as conducive to mutual learning. In committee settings, they play a role in creating cohesion and socialising newcomers into the style (and ergo culture) of the organisation. Experienced advisers suggested that through good collaboration advisers can produce reports that are sufficiently targeted, focused, accessible (with plain language), and timely to be useful to policymakers. One experienced adviser also spoke of the importance of 'post-work delivery', citing a committee they were part of being good at that. But reports often fall on deaf ears. Speaking about a committee they sat on, one experienced adviser said:

I think that... some of [our] reports just didn't get traction [because] they were just too thick and too complicated, and a lot of them were dealing with wicked problems in the formal social science definition. Wicked problems are hard to define, fuzzy edges <h> and all of that kind of stuff. [It] just doesn't get traction.

As central tenets of science advice, reports and other important documents (e.g. minutes) are ubiquitous objects of study in science-policy research. They structure the work of advisers and contribute largely to their learning - not just by introducing unfamiliar subject matter but also by acting as *boundary objects* (Star & Griesemer, 1989) around which advisers have to find ways to reconcile their diverging opinions and mental models⁶¹.

7.1.5 Science advice is about networks

A very important part of science advice that has already come up in different guises is the reliance on networks. Whether these are networks of organisations or individuals, they underpin almost all advisory processes in the UK ecosystem. They are present within

⁶¹ For a discussion of the role of boundary objects in interdisciplinary collaboration, see Freeth and Caniglia (2019).

government departments, between boundary organisations and academic institutions, within the personal diaries of civil servants, and as part of many other interfaces. Interactions between scientists and policymakers, within those networks, is often informal but need not be. Such interactions may include appointed advisers consulting external experts or civil servants and politicians reaching out to a select few trusted advisers and expert organisations time and again. Or they might be self-organised by academic groups and institutions acting as interest groups in policy debates. The entry points are numerous, and this form of science advice encompasses many of the other forms discussed above, with the exception perhaps of science advice as an exercise in 'collaborative writing'.

These networks can be formalised and organised, such as CSaP or Centres of Expertise in Scotland, which one experienced adviser described as one-stop shops for policymakers seeking expert advice on particular topics. A flexible, network of experts was also one of the foundational concepts of SAGE. Conversely, when they are informal and ad hoc, networks are built from the bottom up, relying on personal relationships. In Chapter 6, I spoke about the central role of personal networks in multiplying invitations and assignments to advise. These relationships then matter for individual advisers' personal influence. As one former intern observed: 'I just feel like the power of some academics that have good relationships with these people is huge'.

Within both formal and informal networks, knowledge gaps can quickly be filled. CSAs and advisers on committees rely on a broader network of 'real experts [they] can trust', as one experienced adviser put it. Indeed, for the former CSAs I interviewed, the 'network[s] of excellence' were absolutely crucial. One suggested that learned societies fulfilled an important brokerage function in that regard, adding that - as a 'jack of all trades' - CSAs regularly need to tap into the science world or into more formalised networks to gather the expertise they lack in their immediate vicinity (see A. C. Cooper, 2016). While another recalled that 'in providing the more wide-ranging scientific advice, I had to rely on being able to access experts in whatever area that might [be], for example volcanology to do with volcanic eruptions or whatever, because that wasn't my area of expertise'.

Advisers' own academic networks come into play too. A former CSA told me that it was 'relatively straightforward' for them to deliver a talk on a topic they knew very little about, because they had 'very knowledgeable' colleagues they could speak to in their university. One experienced adviser spoke of how invaluable it was to have 'bright, young post-docs' explain different areas of science to them during their time in a leadership position at a research

council. Illustrating the importance of networks within and amongst academics, a former intern spoke of 'snowballing' as a principal strategy of expert consultation:

The entire time you're just phoning academics and interviewing them, and getting their thoughts; it's not led by you in the sense that [although] you can understand the topic and understand who you need to speak to, it will [then] snowball from there and they'll [recommend] academics or another group that you need speak to, or another paper.

They were surprised to find that senior academics would sometimes refer them to PhD students or post-docs who could provide depth of knowledge on specific areas of concern⁶². This former intern told me that they had not expected such a collegial and supportive spirit amongst academics, which diverged from the kind of competition they had so often witnessed in the science world. Overall, there was evidence that coming to appreciate the value of these networks can be a (transformative) learning experience for less experienced advisers. A former intern said that their internship had 'opened [their] eyes' to the importance of 'good relationships', especially for 'daily evidence needs'. Thinking about what advice they would give their younger self, one experienced adviser said:

I think the thing that I'd have done a lot better when I was younger [would be to] network more. I think that's what you do in Cambridge very well..., [and] because we're dealing with more complexity, those networks are so important; not just purely from the interpretation in a formal way, but the interpretation that involves those parts of synthesis which are not purely cognitive... I think I would certainly have worked harder at that networking. At an earlier phase of my career, I would have sustained them a lot more.

7.2 Organisational cultures and institutional epistemologies

In Chapter 5, I developed a four-level model of learning. I elaborate here on the second of these levels, namely 'organisational culture/institutional epistemology'. Given how entrenched adult learning is with professional identity and the workplace (Knowles, 1984; Knowles et al., 1998, 2005), we can expect the culture of an organisation to play a significant role in shaping advisers' learning. After all, apprenticeship styles in different professional and cultural contexts were the sources of inspiration for the ideas of 'legitimate peripheral participation' and 'situated learning' (see Lave & Wenger, 1991). Since the 1980s, anthropologists have taken an interest in organisational cultures as a cultural unit or object of study (Jordan, 1994), albeit they generally studied the 'informal aspects of organisations' at the expense of 'the dominant

⁶² This is encouraging from the perspective of early-career researchers. Personal connections to individuals who are often consulted on policy issues might lead to advisory opportunities. The networking approach - even within the scientific community - might then be the most effective way of gaining the sort of experience that interviewees claimed you need for subsequent committee work.

formal dimensions of bureaucratic practice' (H. Brown et al., 2017, p. 12). As Brown et al. (2017) argue, an ethnography concerned with organisational culture should equally consider both the informal dimensions of its culture and the banal and mundane aspects of everyday bureaucratic practices. It should also include how individuals view their role in embodying, perpetuating, or challenging the prevalent organisational culture (H. Brown et al., 2017). In other words, an organisational ethnography aims to 'provide a localised understanding of the cultural processes' that constitute the culture of an organisation (Ciuk et al., 2018).

Even though 'organisational settings typically are less immersive cultures' and 'do not monopolise or occupy our social imagination the way that the larger cultural context might do' (Ciuk et al., 2018, p. 272), they are nonetheless fundamental to the study of advisers' learning. In this case, we are not concerned with the whole life journey of the person, but instead with the development of their professional competence. The culture of the workplace they learn to become competent within is therefore an important part of the picture. But it is not just the members of an organisation who adapt and learn, so do organisations themselves. As Pallett and Chilvers (2015) argued in the context of science-policy organisations, there are many ways organisations may or may not learn. They conceptualise organisational learning as 'a productive process, involving the active generation of knowledge and ways of knowing, enabled and constrained by material, social, affective, imagined and political elements' (Pallett & Chilvers, 2015, p. 153). They highlight the importance of an organisation's sociomaterial circumstances in expanding or restricting the possibilities for learning. They point out that organisations, themselves, are far from being static objects. Their learning process is neither top-down, nor unidirectional. And learning is often the product of wider changes in its network, rather than solely the product of internal decisions (Pallett & Chilvers, 2015). A proper appraisal of organisational learning would therefore require a longitudinal study, rather than the shorter, more concentrated period of ethnography that I undertook in my own sites of study. I nevertheless attempt to address these different aspects of organisational culture and learning below.

Given that the business of science advisory organisations is knowledge, it is useful to consider another concept related to organisational culture, namely *institutional epistemology*. This can be defined as 'a stabilised set of practices through which participants in an institutional process produce, combine and negotiate knowledge' (Borie et al., 2021, p. 3). The concept draws its inspiration from related concepts in STS and sociology of science. Those concepts are: *boundary organisation* (Guston, 2001), *civic epistemology* (Jasanoff, 2005a), *epistemic communities* (Haas, 1989), *epistemic culture* (Knorr-Cetina, 1999), and *knowledge*

infrastructure (Edwards, 2017). At the centre of this concept is the idea of how knowledge is organised, validated, and therefore legitimised by different groups within an institution. Studying the institutional epistemology of an organisation involves the scrutiny of its knowledge across its various sites. One particular entry point is documents, which 'bear the mark' of the organisation, representing the explicit position of an organisation on an issue, and which play a role in stabilising and policing knowledge practices within it (Borie et al., 2021). Through the analysis of documentary practices and meetings, an ethnographer can - in principle - reach an adequate approximation of the organisational culture under scrutiny. Supplemented by interviews, for external validation and further context, the ethnographer can begin to unpack the ways in which the organisational culture shapes its members' knowledge practices and learning. I aim to do just that for the following case studies.

7.3 Results from the ethnography of the sites of study

I have already introduced my three sites of study, together with my research methodology and data collection in Chapters 3 and 4. Because more data was collected on Defra SAC, the ensuing analyses are unequal in size and depth. Throughout, I therefore tend to compare and contrast findings from HSAC and CSaP with those from Defra SAC.

7.3.1 The Defra Science Advisory Council (SAC)

Remit and role(s)

The first noteworthy observation is the fluidity, or plasticity, of SAC's remit and role. As discussed in the previous chapter, the ambiguity of terms of reference can leave science advisers with little prior understanding of what is expected of them; they must learn on the job. That can also apply at the committee level. The actual proceedings of the committee will vary with different Chairs, secretariats, clients (i.e. policymakers), budgets, and membership. The terms of reference reflect part of the reality, projecting a certain image of the committee. For instance, the Defra SAC Handbook stipulates that SAC 'provides independent and scientific support, advice and challenge to Defra' (Defra, 2015, p. 2).

The Handbook also lays out that SAC largely services the Defra Chief Scientific Adviser and that it will do so by focusing 'at a high level across all aspects of Defra's evidence, and will have a strategic role, where "strategic" means the process of deciding what evidence Defra needs, now and in the future, and how it should obtain and use it' (ibid.). When it comes to what Defra means by strategic advice, SAC's terms of reference focus explicitly on 'evidence' (mentioned in all five of SAC's objectives) (Defra, 2015, p. 14). However, from my analysis of

three meetings and their agendas, published minutes, and interviews with current⁶³ and former members of the Council, I found that SAC members do much more than that. SAC does not deviate significantly from its terms of reference, but the reality on the ground is far more malleable.

First of all, SAC's role is indeed mostly strategic. I witnessed multiple instances where the Chair or other members reminded civil servants that SAC does not advise on technical details and/or does not have the comprehensive expertise to do so. As one of the SAC members said during a meeting, Defra SAC is 'not the main forum to help with the details'; instead technical details are generally delegated to 'time-limited sub-groups' which can include a wider range of non-SAC experts (Defra, 2015). At one point, one of the members warned that they were going to make a 'technical point' before proceeding. At this high strategic level, SAC members often fulfil the role of *management consultants*. In this trans-scientific role, SAC members draw on their tacit managerial skills to advise the civil servants present at the meetings on policy design (e.g. asking about desired outcomes) and/or strategies for evidence gathering, for example. In fact, most SAC members at the time I conducted my study had extensive experience either in managing large science groups, in science admin at a high level, or in policy for science.

As management consultants, SAC members can be proactive and take on more of a challenge function, as illustrated in meeting minutes by language such as: 'SAC stressed the importance of', 'SAC raised caution', 'SAC encouraged Defra', or 'SAC questioned'. I witnessed one occasion when a SAC member pointed out that a civil servant was implicitly and wrongly assuming that 'if you build it, they will come'. Another challenge I observed came from a member who said something along the lines of: 'a friendly challenge to you [civil servant] about how you are harvesting all the evidence'. Quite often, SAC members would criticise the evidence base in policy documents, in particular the lack of a social scientific perspective. Surprisingly, the point about social scientific evidence was most often made by the natural scientists in the committee⁶⁴, while the social scientists tended to make more technical points about citizen engagement or co-design.

⁶³ By current I am referring to the 2020 calendar year.

⁶⁴ Members I interviewed praised - and said they had benefited from - the presence of social scientists in SAC and beyond. For some of them, interactions with social scientists were transformative. That was the case for one of the SAC members who would advise their younger self to engage much more with social science and social scientists. In all likelihood, they had already been on that learning journey before SAC, although another member I interviewed said: 'a strong representation of social sciences... isn't something I'd really been exposed to [before SAC]'.

From my analysis of SAC's workplan (included in every agenda), I found further evidence that SAC members acting as management consultants was not unique the meetings I observed, but rather a common occurrence - in line with the terms of reference. But although the terms of reference stress the focus on 'evidence' for this role, SAC often went beyond discussing Defra's evidence needs or use of evidence (e.g. improving the use of evidence statements within Defra). One of my interviewees saw this as a strength of the SAC, compared to more technical committees:

A lot of people advise - particularly in working groups -... on technical stuff. As you will have heard in the SAC committee, very few of us actually talk about anything technical. So, nobody is saying: "Oh it's, you know, 4000 units". That sort of stuff. In fact, if we do talk like that, we basically pull each other's leg, and we try not to talk like that because we're specifically trying to bring the skills we have, [with our] disciplinary backgrounds, together [into] something that's much more [of an] innovative kind of conversation. And I think that means that the scientific advisory council for Defra is actually very good, and what matters there is your Chair and your CSA (SAC member).

The trade-off - as another interviewee pointed out - is that SAC is destined to stay at the bird's eye or strategic view on all issues, and can rarely delve deeper into any particular topic. That said, while this is true of discussions and debates within the meetings themselves, SAC can in practice play a more technical, quality assurance role when documents are concerned. Documents that are circulated ahead of meetings (alongside the agenda) have multiple functions; they serve to offer context on the policy a team of civil servants might want SAC to advise on, or ask specific questions to the Council, and hence delineate and frame the areas where advice might be useful and/or welcome (guaranteeing the policy relevance of subsequent advice). In this supply-driven role, framed by documents and documentary practices, SAC act as *peer reviewers*.

The papers circulated in advance of the meetings form the basis of the presentations by civil servants during the meeting, and of the discussions that ensue. SAC members are invited to comment on the papers themselves and/or on the interpretation of it they just heard. More often than not, SAC members would react to what a civil servant said rather than paper itself, even though the Chair kept repeating that they assumed that everyone had read the papers. But sometimes the SAC members would stick more religiously to the document, with one of the members annotating the document, for example, and another one framing their contributions in terms of the paper content directly. The papers were also referred to when it came to highlighting missing evidence or problems with the assumptions about some of the evidence.

As peer reviewers, SAC members fulfil a more traditional and perhaps comfortable function ever-present in the science world. They can provide expert input in written form and can even follow up with specialised teams within Defra on issues that fall within their expertise. However, SAC members are often constrained by being invited to comment too late in the policy cycle. This was evidenced by two separate events: i) the CSA underlining that a piece of work was not 'quite mature enough' to bring to the SAC and ii) a SAC member saying that they would offer different advice if they could see the earlier work about which they were largely in the dark.

Another role that I witnessed was SAC as a *broker* or *convenor*. In this role, they would discuss how best to collaborate with other entities within and outside of Defra or to tap into existing networks of experts outside of the Defra ecosystem. Examples of this role included a conversation on how best to connect arm's length bodies in Defra to the 'cutting edge science' happening outside, and a SAC member telling a civil servant that they were 'happy to give introductions there if that would be useful'. In this capacity, the personal (scientific) networks of the SAC members matter, as discussed previously in Section 7.1.5. Finally, and as specified in the SAC's terms of reference, its members are also there to service and advise the Defra CSA. SAC acts as a sounding board for the CSA first and foremost, who - in turn - acts as a gatekeeper at the interface between SAC and Defra's civil servants.

Boundary work and its transgressions

At the meetings I attended, I observed two forms of boundary work going on. The first is closest to the original meaning of the concept, namely the demarcation of science from non-science (Gieryn, 1983). The second follows the distinction made by Boswell (2018) in a comparative study of the National Institute for Health and Care Excellence (NICE) and the Food Standards Agency (FSA). Boswell (2018) distinguishes between 'demarcation' and 'coordination'. Demarcation consists of practices to keep 'discrete social spheres' separate through institutional arrangements that restrict and confine interactions to 'the negotiation of boundary problems' (Boswell, 2018, p. 489). Coordination consists of 'practices that enable and sustain these new configurations... [and] communication across spheres - engaging in dialogue and producing (or translating) artefacts that are digestible for diverse audiences' (ibid.). In this secondary use of the concept, boundary work helps to determine the division of labour and institutional responsibilities, as well as the levels of autonomy and independence (see Bijker et al., 2009; Jasanoff, 1994; Turnpenny et al., 2013).

Returning to Gieryn's (1983) original concept, I observed that despite all the trans-scientific and high-level strategic discussions, SAC members did nonetheless voice their attempts to

stick to scientific reasoning and evidence. As one asserted, '[we should] identify the areas that are most problematic... in terms of the scientific rationale'. If an issue was considered outside of the scope of 'science', then SAC members might say, and I paraphrase here, 'this is not so much of a scientific issue and perhaps not so relevant to this group' or 'science isn't going to give you the answer'. The strongest boundary was drawn between what SAC members considered political rather than scientific. Paraphrasing once more, I witnessed a member claiming 'that's a small p political question; are you asking from a science and evidence perspective?', and also the CSA apologising for saying 'politics' after pushback from SAC members. At one point, one SAC member got agitated and wrote on the Microsoft Teams chat: '[we] need to separate the political from the biophysical' and 'I get a bit concerned when we talk about taking account of political constraints when giving scientific advice. I feel we should be somewhat countering the tendency for all governments to see environmental actions in the context of what they might consider to be politically possible'.

In these various instances, the role and remit of SAC is also being renegotiated. The boundary work in terms of demarcation of both science from non-science and of responsibilities work hand in hand. For example, one member questioned the remit of SAC, saying that it is not good at the politics, but good at the scientific feasibility. There were however some blatant inconsistencies in boundary work; in particular with the same member who complained about politics interfering, above. On one occasion, they voiced an opinion on the British public's consumption preferences, which was completely unsubstantiated by a body of evidence. This appeared to be in stark contrast to the liberal use of 'evidence' and broad scientific consensus in other parts of the conversation. SAC members would often proclaim variations of: 'very clear evidence', 'quite a lot of evidence', 'pretty clear evidence, and 'widely accepted in the academic community'. They might also refer to areas with significant uncertainties, saying that 'the evidence for that is not clear', for example.

Boundary work of the sort was not only performed by the SAC members but also by the Defra civil servants and the Secretariat. In drawing the boundary discursively, civil servants attending the meetings might explicitly ask for the science perspective on an issue or for opinions on gaps in their evidence base. Boundary work by the Secretariat was far more tangible and material. From my analysis of the agendas, it was clear that SAC's advice was already being structured before the Council would meet. Within the workplan included with every agenda, there was some indication of responsibility and division of labour (e.g. 'Secretariat to consider how to shape future SAC engagement'). The Secretariat plays an

important role in ensuring continued policy relevance and protecting SAC from taking on too much, but there is also an element of filtering and control at play here.

A clear area of control I observed was the AOB (any other business). Not only was the time allocated to AOB very short - and so in that sense it was very much being used as a 'technology of time management' (H. Brown et al., 2017, p. 21) - but the SAC members would also have to send their questions or contributions in advance. The Secretariat could then choose to include them in the day's business, to postpone them, or to dismiss them - although the option of outright dismissal is mostly conjecture from my behalf. In the agenda of the second meeting I attended, all the controversial aspects of an issue discussed in the first meeting had been completely ironed out and SAC's role was revised and reduced to overseeing further research on the topic. Why this was the case and who decided to do so, I do not know, but it was clear that SAC were being spared from continuing the conversations on that particular policy item.

Policy relevance and impact

The most obvious way in which SAC ensures that it is cognisant of the policy matters of the day is its own *modus operandi* for providing advice in the first place. Civil servants are invited to present their work and to ask specific questions or seek some more general feedback from SAC. In that sense, SAC's advice is much more reactive than it is proactive (see Section 7.1.3). In the published minutes I analysed, it was very common to read that the SAC members 'were asked' or 'were invited' to comment or advise on a given issue. In contrast to advisory committees like the RCEP - which chose its topics based 'on issues that had been "floating around"... or had already been established as matters for political attention' (Owens, 2015, p. 59) - SAC members, with the exception of the Chair, have limited sovereignty over the choice of topics to discuss.

As one of my interviewees pointed out: 'the [Council] was being driven to help with immediate political questions, as opposed to what might be called normal business-as-usual for Defra'. In this reactive mode, one of the interviewees said that the job of SAC was to help policymakers understand and navigate contentious issues by providing an opinion on why it might be contentious in the first place. Because of this dominant way of operating, one member complained of a lack of 'continuity in [SAC's] thinking' and that the SAC 'keep[s] dropping things'. Another member said to me in the interview that the workplan 'looks awfully like when I joined'.

From what I could gather, the CSA, Chair, and Secretariat co-design the agendas and the workplan for SAC. They also provide indications of how open-ended a conversation ought to

be. The discussion points in the agendas and workplan might indicate whether SAC can freely discuss the matter or whether they ought to find concrete resolutions or recommendations. In the minutes, the open-ended discussions would be embodied by words like 'SAC determined', 'discussed', or 'considered'. All this backstage work would also make an appearance, frontstage, in the performance of the CSA Update - an important ritual in SAC meetings and always the first item on the list⁶⁵. In their update, the CSA might contextualise the business of the day and indicate where advice might be most needed. The CSA might also give an overview of the latest developments in Defra, ensuring that SAC is plugged into the department.

Overall, the CSA and the Secretariat act as gatekeepers and as brokers between the Ministers' and departments' concerns and the SAC. At one point, the CSA defended one of the civil servants' papers in response to criticism from SAC. There was a sense that SAC's agenda was also being driven by the CSA's (received) priorities, with one example of an issue that the CSA was asked to park, and some parts of the high-priority items workplan looking like sketches of the CSA's thinking. I also witnessed an instance where the CSA sought to prevent an item from becoming set in stone in the agenda and instead asked to follow up backstage with the Chair.

In the meetings I observed, SAC members explicitly discussed the delicate balance between robust and relevant advice. For instance, one of them spoke of the 'tension between practicality and quality assurance'. Another member highlighted that the conversations in one of the technical sub-groups they were chairing were not very policy relevant or useful, precisely because they were not high-level enough. SAC members were in fact quite transparent about their desire to have an impact; they mentioned on various occasions the importance of narrative (e.g. 'all in the narrative') and getting the framing right. They even had a whole meta-level conversation about framing in one of the meetings. They also mentioned 'policy levers', 'policy angle[s]', and political acceptability in different forms. For example, one of the members said that the 'cost-impact-benefit calculation will be politically contentious and needs discussion' - implying that if it's 'politically contentious' it would have no impact.

All in all, I found that SAC had many safeguards in place to ensure its continued policy relevance, not least the way it responds directly to civil servants' concerns and questions. One additional mechanism that was mentioned to me was the pairing scheme they have in place.

⁶⁵ Following Hilgartner's (2000) analogy, the CSA update is one element of SAC's 'stage management'.

One of my interviewees explained that SAC members are paired with a senior civil servant when they first join. The pairing scheme creates opportunities for informal advice, depending on the working relationship that comes of it. From my research, there is no doubt that SAC members have many opportunities for impact, albeit tracing that impact as an external observer would still be extremely challenging.

Cultural foundations and dynamics

SAC's organisational culture has many sociomaterial foundations, some of which I would like to tease out here. Firstly, the multidisciplinary nature of its membership, with one interviewee suggesting that the 'diversity of SAC membership' and the 'full range of expertise' in the Council was good for taking a systems or 360-degree view. Conversely, and from the scientists' perspective, the Council lacks the expertise to comprehensively address the extensive range of issues covered by Defra and therefore deliberations should remain at a high, strategic level. On several occasions, I witnessed SAC members telling the civil servants that they did not have the expertise to address particular questions. For example, at one point the Chair reminded the civil servants that SAC had 'no hydrologists' and therefore SAC would most likely provide higher-level advice on 'how to harness evidence'. On another occasion they said: 'bear in mind, we're not experts'.

The second cultural pillar is Defra itself. As one of the Secretariat staff put it to me: 'SAC is very core Defra'. One SAC member I interviewed claimed that Defra's culture around evidence and data stands 'in stark contrast to other Ministries... where decisions are taken for political reasons'. This was helpful for another member, who told me that they had an easier time dealing with Defra's evidence-informed culture compared with their experience taking part in a polarising public debate. Ironically, it was Michael Gove - who famously said that the UK had 'had enough of experts' on national television - who was considered by my interviewees as the Minister who did the most for evidence-informed policymaking within Defra⁶⁶. Although, according to one SAC member, respect for evidence does extend beyond Defra: 'a network of Chief Scientific Advisers, has sort of embedded within the culture of Whitehall a respect for evidence and a sophisticated way of understanding how evidence leads into policy formation'.

Another pillar is SAC's national cultural idiosyncrasies, its Britishness (see Chapter 5). One obvious point of Britishness in the meetings I observed, was the level of self-deprecation in the room. Self-deprecation was used as a way of defusing tensions and/or creating rapport

⁶⁶ A good example of how one needs to be 'on the inside' when it comes to policy and political cultures. An external adviser might not see Gove in the same light.

(see Swinkels & de Koning, 2016 on the importance of humour in building social relationships). Of the many ways it can be deployed, self-deprecation can be used to gain agency from a position of weakness (Carty & Musharbash, 2008) or 'detract' from the 'high status' of expert (Dyer & Keller-Cohen, 2016). I also observed humour being used cathartically to deal with the weight or often the absurdity of the big-P politics involved. Another, perhaps more interesting aspect of British national (political) cultural, was the frequent invoking of 'pragmatism' on multiple occasions. Pragmatism was used as a depoliticising term to stand in for political feasibility. Examples mentioned in the meetings included: 'looking at the most pragmatic way', 'realisable is the determining factor', 'pragmatic realism'.

There was also a quintessentially Sir Humphrey⁶⁷ flavour to some of the language used. For instance, I witnessed the use of 'barriers' to describe the reluctance of the public or politicians on particular issues. A civil servant said they refer to the divergence of public opinions with the scientific evidence base as 'conflicts of knowledge' which should be resolved. At one point, a SAC member suggested that 'governance could be a shorthand term' to get around political resistance - within the department - towards multi-stakeholder co-design for a particular policy. Finally, 'steer' was used liberally both orally and all over the agendas and workplan, as a soft way of characterising political agenda setting.

SAC's organisational culture also heavily depends on the Chair and the CSA, as well as the Secretariat's work in the shadows. The style of leadership and vision of a Chair is absolutely crucial to the functioning of an advisory committee. The members I interviewed praised Sir Charles Godfray's chairmanship, crediting him for 'letting people have a say, but not letting it go round and round', synthesising what had just been said in a way that fosters consensus and captures the essence of the discussions, being interdisciplinary, and 'keeping to time'. For one SAC member I interviewed, without his chairing skills, SAC 'would be very unwieldy'. The role of the Chair in fostering the policy relevance of SAC through the promotion of a welcoming culture and safe space for civil servants was confirmed by one of the interviewees who said that the previous Chair had been less plugged into Defra and less open to civil servants coming along.

Finally, while teleconferences were commonplace before the various COVID-19 lockdowns, they would only happen for shorter meetings. The four-hour meeting format used to include

⁶⁷ Sir Humphrey Appleby was a fictional character of the famous *Yes Minister* and *Yes Prime Minister* political satire comedies, aired between 1980 and 1988. He is first a Permanent Secretary and later becomes Cabinet Secretary - the highest position in the Civil Service. His whole character is based on his mastery of the English language, which he uses to dissimulate information from the politicians he serves or to confuse them.

a full day on Defra premises, with the occasional meal with Ministers or senior civil servants. For one interviewee, the switch to Microsoft Teams was a learning curve and although it was nicer than teleconferences - because you could actually see people - it was no substitute for the in-person meetings they used to have. The switch to remote meetings had two notable consequences: firstly, the replacement of small talk at the beginning of the meeting by jokes about tech (e.g. muting yourself or struggling to get the webcam going), and secondly the use of the chat function, which became a backstage in plain sight or even a parallel meeting space. A lot of the most fascinating nuggets of personal opinion and disagreement between members made their way onto the chat. The extent to which the change in meeting format has led to a marked change in SAC's culture, I would not be able to determine, but I suspect that it has had some effects nonetheless.

Reflections on learning

SAC's culture and operations have important consequences for members' learning. As the scientific advisory committee that directly advises the Defra CSA, the SAC appears to be both much more connected into its host government department and much more focused on high-level strategy than more traditional advisory committees (e.g. HSAC, which I will talk about in the next section). Moreover, civil servants join SAC meetings and present some of their work - framing where SAC's contribution can be most valuable. This model has many advantages, but also means that SAC is highly demand-driven. By being plugged into emerging departmental needs, the SAC assures its constant policy relevance but then acts as a sounding board in a way that differs significantly from curiosity-driven or issue-driven deliberations in more traditional committee settings.

SAC members might, in consequence, equate usefulness or the role of a science adviser with reactive science advice, as opposed to more proactive work such as horizon scanning⁶⁸, for example. SAC members also appear to be less anxious about their independence, especially compared to members of more traditional advisory committees. With the exception of one SAC member expressing some nervousness about politics creeping into their discussions, all SAC members seemed fairly relaxed about their servicing and reactive role. They preserved and performed their independence through routine boundary work and, as one interviewee suggested, 'I think that group of scientists <h>, would not have independence issues; they

⁶⁸ SAC do in fact carry out some horizon scans, but they seem to be quite low priority and relatively ad hoc, from what I could gather.

are all very senior people'. This interviewee is suggesting that *self-assurance*, alone, can sustain sufficient independence.

Ultimately, the SAC members enjoy their time on the Council. Those I interviewed found it rewarding and intellectually stimulating. Although, going back to the point about seniority and levels of experience mentioned in Chapter 6, there is no doubt that SAC would be a great challenge for a shy, less experienced adviser. Self-assurance and prior experience in managerial roles are evidently important to become part of the community of practice that is SAC. Moreover, the experience is not without its frustrations, as the earlier comment on lack of continuity illustrated. One of the interviewees also said: 'we have to accept that we're not all going to agree all of the time', adding that it was quite a steep learning curve to come to terms with the diversity of SAC members and of the Council's remit.

SAC members have to face a number of challenges - with each other, with the CSA, and/or with the audience of their advice. They have to learn to accept the frequent 'shifts in political narrative', as one of them put it. They have to learn to accept that there are some policy options that are off the table altogether, regardless of what the evidence suggests. They have to learn to recognise what the CSA will and will not accept as valid evidence. They have to accept the high turnaround of discussion items from Defra colleagues. They have to learn to navigate these and other difficulties which come with solicited, formalised, and reactive advice at such a high level in Defra.

7.3.2 The Hazardous Substances Advisory Committee (HSAC)

Remit and role(s)

HSAC's terms of reference are much shorter than Defra SAC's (see Defra, 2020b). The aim of the committee is to act as an 'independent scientific advisory body providing expert advice' on matters related to 'potentially hazardous substances, articles, and wastes' (Defra, 2020b, p. 2). Interestingly, HSAC's relationship with Defra is framed as engaging with the Defra CSA - 'and through them, the Defra Science Advisory Council' - and supporting them 'as necessary, during emergencies' (ibid.). Whether or not this happens systematically, I do not know and would not have sufficient data to make a claim either way. Overall, HSAC's terms of reference mirror more closely what we might expect from a more traditional advisory committee. Like Defra SAC, though, HSAC performs a variety of roles in practice.

For the most part, HSAC appears to be quite reactive to incoming requests from Defra and other government agencies, including by having civil servants coming to present their work. This was confirmed by the member I interviewed, who said that HSAC was more responsive

to Defra's questions than other committees they had sat on. At the meeting I observed, they also discussed an upcoming horizon scanning exercise which they were being invited to advise on and take part in. So, there was some evidence of solicited, proactive advice.

The Secretariat staff member I spoke to saw HSAC as 'critical friends' of Defra. During the meeting I attended - and in the documents circulated before it - there were several instances wherein HSAC acted as a peer review group, where, according to the one HSAC member I interviewed, the 'committee [is] at its best'. Some meeting documents would frame HSAC's contribution as peer review; asking for 'verification by an expert or an expert group' or containing a 'request that HSAC members review the proposal'. In that reviewing role, HSAC members might occasionally slip into the management consultant role, but far less so than Defra SAC.

I also witnessed HSAC acting as a broker or convenor, with members being explicitly called upon to tap into their personal networks for expertise for a future horizon scanning exercise, for example, or thinking about procedures for further collaboration with other advisory or governmental entities. In general, the role and expected contribution of HSAC was quite strongly framed in the meeting documents circulated ahead of time (with various degrees of open-endedness); something I could not confirm for Defra SAC. Each document would contain one or two cover pages prepared by the Secretariat, which would offer some context, definitions, and most importantly some defined problems or areas where HSAC's advice is needed or welcome.

Boundary work and its transgressions

While I have no doubts that this documentary practice is mostly there to ensure policy relevance and protect the committee from overwork, it is also a policing mechanism (although there is no guarantee that members will follow suit). This way, expectations are framed from the beginning, even before the broader policy context and details of the policy in question (if applicable) are presented. This can also be conceived as a form of boundary work that allows both parties to determine where the boundary lies between issues that fall within the umbrella of science advice and issues that are judged beyond its scope.

The main evidence of performed boundary work within the observed meeting revolved around the deployment of expertise. In a very similar vein to Defra SAC, HSAC members would announce when they were about to make a technical point or if they did not have the expertise to speak on a particular topic. For example, one of them said 'it's not my area of expertise per se' and 'again, please accept this from a place of ignorance'. With regards to overstepping

boundaries, there was one instance of a fairly political statement made by one of the HSAC members, but it remained quite tame. Broadly speaking, HSAC stuck quite religiously to discussions around evidence and evidence gathering.

Policy relevance and impact

From the perspective of policy relevance and agenda setting, the Secretariat is the main proactive actor in discussions with government colleagues across Defra and beyond. The HSAC Secretariat seemed to manage virtually all backstage conversations and interactions. The extent to which the Chair was involved in those conversations was unclear from my observations. While they proved invaluable for SAC members, the documents prepared and circulated ahead of meetings by the Secretariat did not appear to give sufficient information on context, with civil servants providing additional information orally at the meeting I attended. Advisers also routinely asked for further policy context, as in the case of one adviser who asked about the timing of the Environment Bill. Whereas with Defra SAC, the Chair seemed to be plugged into everything and the policy context would also be provided by the CSA, HSAC seems to be at greater arm's length. According to a member of staff, HSAC generally has to contend with a lack of awareness and knowledge of HSAC's work amongst civil servants, as well as a lack of skill in asking the right kinds of questions.

Cultural foundations and dynamics

With only one social scientist, the composition of HSAC is interdisciplinary but in a narrower sense than Defra SAC - with a majority of natural scientists in and around the fields of environmental toxicology and/or chemistry. Despite its remit being narrower than Defra SAC's, the HSAC member I interviewed told me that HSAC did not have a particularly strong 'underpinning philosophy' permeating everything it did; certainly not in comparison to the Natural Capital Committee (NCC), which they used as a counterexample. In terms of transparency, HSAC seemed more open than Defra SAC (e.g. in sharing the meeting documents with me or in their horizon scan planning), but there were still residual elements of the Civil Service's culture of discretion and/or secrecy.

In terms of chairing style, while SAC's Chair ran an impressively tight ship, I found HSAC's Chair to be far more relaxed - moving the conversation along, but rarely needing to cut anyone short or pressure them to wrap up, nor seeking to synthesise or paraphrase as much as SAC's Chair. Most strikingly, no one addressed HSAC's Chair directly, which was the case in SAC. It would seem that the HSAC's Chair's more laissez-faire approach keeps the committee at arm's length; on standby to help Defra on the matters they bring up.

One final thought prompted by one of the civil servants attending the meeting who said it was 'worth highlighting that the call for evidence is a very technical document', was whether the announcements of technical talk was in fact a manifestation of a broader cultural norm. Whether it was a Whitehall cultural trait that advisers assimilate, a by-product of science-policy interactions, or a Defra-specific quirk, I could not say, but it was an interesting finding nonetheless.

Reflections on learning

In terms of the Secretariat's role in fostering learning, HSAC appears to have an onboarding system for new members and new civil servants, and, indeed, one of the items on the meeting agenda was about new civil servants introducing themselves to the committee. It seems that HSAC develops closer ties with particular Defra teams than Defra SAC, which makes sense given how the greater breadth of SAC's remit. One HSAC member mentioned that it would be easier to build relationships and train newcomers with face-to-face meetings, while another HSAC member raised the concern about institutional continuity and memory, given the very high turnover of civil servants. I also found out that HSAC has a 'lessons learnt' document, which was suggestive of sustained efforts to encourage organisational learning. In terms of opportunities to observe real-time interactional learning, I discovered at the meeting that committee members exchange and deliberate via email outside of the meetings - implying that some disagreements might have been ironed out backstage beforehand. There was no evidence of this happening to quite the same extent in the case of Defra SAC.

7.3.3 The Centre for Science and Policy (CSaP)

Remit and role(s)

Unlike Defra SAC and HSAC, which combine different modes and models of science advice, CSaP is primarily designed with one model of science advice in mind: advice as a network. As a catalyst of relationships, CSaP invests in the building and nurturing of networks of policymakers and scientists. 'CSaP's mission is to help improve the quality of public policy making through the more effective use of evidence and expertise. CSaP starts with the questions from policy professionals and fosters networks between policy and science based on mutual understanding, respect and trust' (CSaP, 2022a). One of the experienced advisers I interviewed described CSaP's role as being 'glue' - highlighting that it is 'incredibly effective' at building networks. While CSaP's activities go beyond their Policy Fellowship scheme, it remains their flagship programme.

Each Policy Fellow (PF) is asked to draft some 'objectives' and questions for their visit, which are then circulated to the academics the PF is scheduled to meet (organised by CSaP). The PF I followed framed theirs both in terms of their short-term needs within the Department for Business, Energy and Industrial Strategy (BEIS) and longer-term departmental goals. The questions were quite open-ended and many of them welcomed normative and/or subjective responses (e.g. 'how should...'). They started quite broad and became increasingly technical. Some of the questions were about improving policy directly (so more policy advice than science advice) for example: 'how should policymakers strike this balance?'. It was unclear to me whether CSaP provides guidelines on how to draft and/or organise the questions.

At the beginning of most meetings, the PF and academics would exchange bios. The PF would then proceed to laying out their interests and questions, sometimes with implicit assumptions of where and how the academic's expertise might fit in the picture. On different occasions, the academics began by asking questions of their own - often with the objective of learning more about the current (policy or political) context within BEIS. The extent to which academics stuck to these questions, or prepared for the meetings with the questions in mind, varied. In running the meetings, the PF - themselves - rarely referred to the questions directly. One communication strategy they all shared, was the liberal use of examples and analogies (e.g. 'let me give you a very concrete example'). In this mode, the academics would perform their roles as information providers and translators.

Boundary work and its transgressions

The advising and communication styles of the academics differed. Some of them came across as quite opinionated, with strong normative positions on the issue at hand and/or strong adherence to a particular paradigm. In fact, one of the academics even pointed out - at the beginning of the meeting - that the PF was going to hear parroting of commonly-held mental models from colleagues, adding that 'people say what they think policymakers want to hear'. This academic then went on to directly debunk some of these widespread views with data or lack thereof.

Another surprising observation was that the PF seemed generally more concerned about (scientific) certainty than most of the academics, who would often use the imperative mood, in contrast with the more nuanced language of uncertainty you might expect from advisory reports. Language with relation to the evidentiary base included 'a settled story' and 'all the theory & evidence [suggest]', for example. At times, the style of communication was so forthcoming that it seemed more like advocacy than advice. One academic even said at one point: 'let me give a strong, political pitch now'. They did proceed to back it up with numbers,

perhaps to suggest that the evidence was speaking for itself, but it would nevertheless have been an unexpected phrase to hear in a Defra SAC or HSAC meeting.

Indeed, conversations would occasionally veer towards advice on how to frame a particular policy idea to convince Ministers or how to deal with other cross-departmental conflicts. Some of the more confident (or self-assured) academics attempted to help the PF navigate the various interests and political stakes, with their advice more geared towards making a case to politicians than policy design per se. Guiding policymakers to navigate political complexity was what a SAC member I interviewed saw themselves doing, and connects directly the question posed by the PF about striking a balance (mentioned earlier). Although this sort of advice might end up being the most impactful, it is clearly a transgression of the traditional boundaries of science advice.

Across meetings, the academics would speak to their area of expertise, but the boundary work was so subtle that it felt almost non-existent. The conversations often ended up in the territory of trans-science (Weinberg, 1972) and/or speculation (e.g. about public preferences). Even though there was some of the same kind of deployment of limits of expertise as observed in Defra SAC and HSAC (e.g. 'the right question [but you are] asking the wrong person'), it was less systematic and probably more sincere. When that happened, the academic generally would suggest a colleague or expert to talk to on the particular topic at hand.

Policy relevance and impact

Unlike with the advisory committee model, policy relevance is hardly a concern in these one-on-one settings. Then again, the impact of PF visits is harder to trace because causality is even less clear (as acknowledged in Musa & Burgess, 2019). One interviewee told me they nearly never have a sense of whether PFs read the materials they send after the meetings and, if so, how they influenced their thinking. However, with CSaP, both interviewees suggested that the impact might not be in the advice given at the time of the PF's visit but through the subsequent relationship. This is what one of them said to that effect:

The thing about CSaP is the ongoing relationships... You know, success isn't: "we had a one hour chat"... [And] success isn't necessarily: "did either of us learn anything from that conversation?". It might be that in nine months, a year, five years, they ring me up or somebody else they've met and say: "so, I now work on this thing, can I talk to you about this thing?"... You know that that relationship is there ready and waiting. [Or sometimes] we didn't know when we first spoke that [what we discussed] would be useful, but now we know that it was.

Cultural foundations and dynamics

The physical and sociomaterial settings of the meetings clearly had a bearing on the conversations. They ranged from a private study in one academic's own home, to a public university cafeteria (the latter was mostly empty due to the pandemic), to Zoom. Out of earshot from individuals, the PF appeared to feel more comfortable to share confidential information, with one instance where they explicitly announced they were going to say something 'off the record'. There were some short conversations on the edges of the meetings, but the information shared there was not particularly important or sensitive. Those exchanges were more important in building a relationship than anything else. In that sense, they were similar to the small talk at Defra SAC and HSAC meetings. Within and outside the meetings, humour was omnipresent. It was often used as a cathartic way of dealing with some of the absurdities in government (as was the case in Defra SAC).

Some of the academics I observed embodied - and perhaps even caricatured - academic culture at times by talking about their own research (i.e. 'we're writing this paper for...') or the beauty and elegance of a piece of academic writing (i.e. 'one of the nicest papers...'). One of the more junior academics said that they were interested in what the PF was talking about, but unfortunately 'didn't get a grant' to test their 'hypothesis'. The academics might also summarise a paper in a few sentences or give the PF a reading list, and both a less experienced and a very experienced adviser suggested to send the PF recommendations of paper to read in an email following the meeting.

It was unclear to me whether there might be a correlation between lack of advisory experience and the extent to which academics fall back on this sort of (very academic) advising, although, interestingly, levels of experience did not seem to account for how the meetings unfolded. Some of the meetings ending up looking like an interview, with the PF as the interviewer, while others looked surprisingly like supervisions (Cambridge's version of small group seminars). In fact, in the brief before the meetings started, the CSaP staff warned the PF that some of them might feel like supervisions.

Finally, there was some evidence of snowballing of ideas and people. The PF would occasionally bring up bits and pieces from previous conversations, either to check assumptions and or to get further confirmation. The academics would often recommend other academics to talk to - one of the principal manifestations of the mode of science advice as a network. Moreover and from the perspective of argumentation, academics would routinely enrol other people's work (often colleagues) to defend their opinion or they would position themselves in opposition to what others have been saying. One even mentioned that a Nobel Prize winner

had similar views. These referencing practices are pretty standard academic practice (i.e. cultural norms), and can be linked to Latour's (1987) idea of *allies*⁶⁹.

Reflections on learning

Advisers' policy literacy and anterior learning was clearly important in the meetings I observed. By mentioning their previous experience working directly with BEIS or similar agencies, a few of the academics established their credentials very early on in the conversation. Through subtle mentions of their own advisory experiences and networks, they would also legitimise their involvement in these CSaP meetings in the first place. An academic's level of policy experience seemingly played a role in how comfortable the PF would themselves be in sharing details about internal BEIS and Whitehall politics. By displaying their own knowledge of the various political and time constraints and pressures that the PF was under, the more experienced academics were able to quickly demonstrate expertise and empathy, and hence build trust. A number of the academics I observed also provided comparative references to policies in other countries - which they supplemented with qualifications of why it would or would not work for the UK - and in so doing, demonstrating their knowledge and experience of the particularities of British politics and policymaking.

Despite a CSaP member of staff mentioning in the morning brief that academics 'learn just as much' as the PFs, there was no clear evidence that the two academics I interviewed had themselves learned much from the meetings (except further context on what is going on within BEIS). One said the conversation was 'a pretty sobering reminder that the stability of British energy policy is less than impressive', while the other told me about another PF who gave them 'a fantastic lesson... on exactly what was going on. Like it really educated me immensely'. But the value of meetings varies significantly:

Some of them have largely consisted of me learning from the policy fellow, some have largely consisted of me talking [about] politics [with the] fellow... Sometimes it's me talking about things that I do know about; so subject matter material. Some have been frankly a waste of time and tedious, or just didn't kick off. Others have developed into relationships where we've stayed in touch for quite a long time.

In terms of academics' learning, the propensity for transformative learning will also depend on the character of the PF; if they are deferential and polite, then there might not be enough pushback or feedback to create a *disorienting dilemma* and ergo trigger transformative learning. Some conversations do have transformative effects though, especially the most

⁶⁹ Latour (1987) discusses the importance of enrolling 'allies' in building scientific arguments (e.g. through citation practices) or 'argument[s] from authority'.

unusual ones. For one interviewee, the unusual conversations are the true power and value of CSaP's approach. They recounted the following (fictionalised) story:

A policy fellow once told me about their unexpected meeting with a professor of ancient linguistics. They recounted that they had initially thought that this meeting would be a complete waste of time and wondered why it had been scheduled in the first place. But then, they ended up having a very engaging conversation about the history of the word 'sustainability'. And that conversation - which was utterly bizarre and unexpected - was also the most memorable and transformative in their visit. And I think that is the real power of CSaP. Policy fellows might already know some academics in Cambridge because they are considered the experts in their policy area, but they'll kind of already know what these experts will say. Instead, it is sometimes the ones where you're like: "I didn't even know that that was a thing that I ought to be thinking about", that bring the most value.

We can also assume that something similar would happen - to a degree - the other way around; i.e. when an academic has a very unusual encounter with a policymaker. That would be consistent with Mezirow's (2000) theory of transformative learning. In any event, this anecdote links back nicely to the earlier discussions on serendipity and chance, as well as the importance of interdisciplinarity (see Chapter 6) - even in the model of science advice as networks.

7.4 Collective and networked intelligence

Based on the analysis of the three case studies above - as well as the various modes and models of science advice proposed by my interviewees - I have devised two high-level models of science advice in the UK, each with their respective effects on advisers' learning. I sketch them out, below.

7.4.1 Collective intelligence model of science advice

I am calling the first of the two models the *collective intelligence model of science advice*. It can be summed up with the idiom: 'the whole is greater than the sum of its parts'. As Malone and Bernstein (2015) suggest, 'there have been almost as many definitions of collective intelligence as there have been writers who have described it' (p. 2). For our purposes, I propose that we view collective intelligence as the irreducible assemblage of knowledge that emerges from high-quality deliberation between people with different expertise and perspectives⁷⁰. Through group deliberation, communities of practice co-produce knowledge outputs that depart from what a simple amalgamation of individual contributions would yield.

⁷⁰ I borrow the definition from Brown (2008): 'a perspective consists of a set of deliberative resources arising from either shared social experiences (e.g. unemployment, racial discrimination, pregnancy) or shared intellectual background and training (e.g. microbiology, theology, anthropology)' (p. 548).

The collective intelligence model can generally be encountered in scientific advisory committees and other formalised and structured advisory environments; it is the principal model governing Defra SAC and HSAC, for example. Advice can be reactive or proactive, and the advisory activities often revolve around collaborative writing. The proponent of the collective intelligence model believes that deliberative and collaborative practices are more desirable in science advice than a set of strong voices and/or voices with influence. If the quality of science advice is to be equated with the irreducibility of the products of group deliberation, then the principal determinants of this model are going to be: i) the quality of deliberation and ii) the diversity of perspectives being deliberated. Other factors like leadership, competence, mutual respect, individual personalities, and so on, are also important, but I will chiefly focus on the aforementioned two.

What makes for good deliberation is for the most part intangible, but there are some best practices and lots of existing knowledge (e.g. research on deliberative democracy and citizen assemblies). In the collective intelligence model of science advice, a 'lowest common denominator' or 'low hanging fruit' approach can be symptomatic of bad deliberation, but not always. The results of good deliberation are never prescribed or predetermined; they must remain unknown until they take shape and they must be emergent. With regards to learning, deliberation is of high quality if it encourages and opens up space for participants to learn from each other and - through mutual learning - to formulate a collective position on a topic. As Budwig (2015) suggests, what is 'essential to open-ended communities of practice is that both at an individual level and a collective community level the group believes they are working collectively to frame and solve important problems', and 'learning flourishes when diversity is enhanced and all participants can stand to learn from the diversity of expertise in a group' (p. 102).

In that sense, good deliberation can be identified by the extent to which the final product is different from the worldview of any single participant. The product of deliberation is new knowledge built on compromise and/or convergence. Many academic collaborations can be described in exactly those terms, for example. In the effort to build consensus, members of a committee have to be empathic in order to understand the views that they so fervently disagree with. In that sense, the pursuit of consensus can also open up opportunities for learning. And whilst consensus need not be the ultimate goal of a collective intelligence process (see Horst & Irwin, 2010 on the political ideal of consensus in public engagement exercises), it will often be sought after; not least because politicians expect and/or prefer a consensus view from science advisers (see Stirling, 2010).

In order to ensure that the science advice outputs are emergent and co-owned by all members of an advisory committee, the right kind of organisational culture needs to be in place. As we saw in the case of SAC and HSAC, the Chair is a key individual in creating the environment for collective intelligence to flourish. A Chair who is respectful and welcoming of various disciplinary perspectives will facilitate opportunities for mutual learning and enrichment. I should add that, although diversity of expertise is no safeguard against 'group think' (indeed there are many ways a group can be homogenous beyond subject matter expertise), a mix of expertise is likely to increase the amount of relational learning between participants - as they are repeatedly presented with knowledge claims or questions that are beyond their individual comfort zones. Ensuring that a diversity of disciplines and perspectives is present, in the first place, involves upstream work on the composition of a committee.

The philosophy and open-mindedness of the sponsor or manager of the committee (e.g. secretariat) will be just as important. In that sense, some institutional settings and epistemologies are better at incentivising or making space for good deliberation than others. My interviewees pointed out that Defra was perhaps unusually open to interdisciplinary science and science advice, and Defra is also recognised as exceptional - amongst government departments - for its science advice ecosystem (see Sasse & Haddon, 2018). Moreover, the available resources (including time) and the general power dynamics at play (e.g. between committee members) are going to shape the space for innovative and constructive deliberation. All in all, these different elements point to the importance of leadership and vision.

In terms of leadership - and as illustrated by the cases of SAC and HSAC - the Chair does much more than just encourage interdisciplinarity⁷¹. The Chair often sets the agenda. The Chair is a facilitator of conversations and makes sure everyone feels comfortable enough to contribute. The Chair is a synthesiser, condensing what has been said into digestible soundbites. The Chair is a timekeeper and polices the conversations to make sure they do not stray away from the core topic at hand. The Chair protects the committee from overwork. The Chair is a broker between the secretariat, as well as other government actors, and the members of the committee. In the case of SAC, it was fascinating to see that all SAC members would address the Chair directly when they would make an intervention. A former member of SAC emphasised to me that Chairs have different styles that influence the direction and operation of the committees they preside over. From a learning perspective, Chairs act as

⁷¹ Turnpenny et al. (2013) describe the central role of the Chair in the UK Parliamentary Environmental Audit Committee's commitment to evidence-informed policymaking.

guides when it comes to legitimising newcomers and imparting the culture of the organisation onto them (see Lave & Wenger, 1991). Chairs can also be role models for less experienced advisers. That was the case for one of my interviewees who told me that it was a 'kind of masterclass' to observe the Chair of the first committee they sat on. They added that the Chair was so neutral that, years later, they were still not sure what the Chair's personal opinion was on any matter.

When it comes to policy relevance and impact, good deliberation based on diverse perspectives is no guarantee. By trying to accommodate multiple perspectives, science advisory outputs - such as reports - can become too complex for policymakers and politicians who would rather have silver bullet solutions. And the sheer amount of time that it takes to produce these reports means that policy windows can easily be missed. On the other hand, the comprehensiveness of those advisory outputs means that they might age better and eventually be taken up by policymakers looking for an integrated approach to a particular policy issue further down the line. Indeed, there is some evidence that the products of such deliberations might be more resilient to political sways than other science advisory outputs (e.g. Owens, 2015 on the RCEP). Furthermore, the reports emerging from a collective intelligence process are not only co-designed by the members of the committee, but generally also with the secretariats. In some cases, the first draft of reports is written by committee members, but it is more often produced by committee secretariats; in which case committee members are subsequently called upon to act as peer reviewers.

Given the limited amount of time advisers are compensated for, not only is this a pragmatic approach to science advice, but it arguably also maximises learning and impact⁷². Members of the committee learn from the framing and language employed by their colleagues who are much closer to the policy world than they are. Through this collaborative process, advisers at arm's length from government learn about the government's policy cycle and concerns of the day, and adapt accordingly.

7.4.2 Networked intelligence model of science advice

I am calling the second of the two models the *networked intelligence model of science advice*. It can be summed up as the 'address book' approach to scientific advice. In this model, a policymaker or a policy organisation has go-to people or institutions. Networked intelligence is the act of collecting and collating expert knowledge (i.e. the nodes of the network). It involves building new relationships (i.e. the links of the network) between institutions and/or

⁷² Although this might conversely mean less deliberation between committee members.

people or nurturing existing ones. While collective intelligence necessarily involves some degree of deliberation and co-design at the stage of knowledge production, networked intelligence can be harnessed by individual actors or by knowledge brokers and other boundary spanners. CSaP is an excellent example of an institutional knowledge broker in this space. Networked intelligence is not only CSaP's operating model but equally its philosophy of impact. Other examples of institutional knowledge brokers - or boundary organisations (Guston, 2001) - include learned societies and research councils. These sorts of more formalised networks are generally more visible and easier to trace than informal ones - although the advising itself will often remain informal and behind closed doors.

When the central node or instigator of the network is an individual, the whole network might be contained in the personal diary of a civil servant or parliamentary clerk, for example. In that case, the nodes are the contact details of academics with whom they have built trusted relationships. These sorts of networks are invisible to most observers and even to the individual nodes of the network. Insofar as I am gathering and interpreting knowledge from various actors, my PhD could also be characterised as a product of networked intelligence, where I am the sole knowledge broker. The networks can and often are hybrid - combining formal, informal, institutional, and personal networks.

Regardless of the type of network, the emphasis of the networked intelligence model of science advice is on the 'intelligence' and expertise brought to the table by the different nodes of the network and the strengths of the connections between them. Such networks principally grow and evolve through snowballing and/or word of mouth, and personal relationships are paramount. As was the case with all three of my case studies and for many of my experienced advisers, personal networks regularly get plugged into institutionalised ones (e.g. making introductions).

In the networked intelligence model, the determinants of success and learning are somewhat less tractable and more individual (advisers' characters, communication styles, etc.) than in the collective intelligence model. The profile and skills of individual science advisers - and especially their interpersonal skills - play a central part. As we saw in the case of CSaP, demonstrations of extensive experience with policy and/or politics can have important repercussions on the directions conversations with policymakers take. Being able to demonstrate empathy - as well as knowledge of the policy context - can help to foster mutual understanding and trust. By ticking all the right boxes, advisers can make themselves increasingly useful and helpful.

In terms of policy relevance, there are immediate feedback loops in the networked intelligence model, something that is not necessarily the case with more arm's length bodies operating under the collective intelligence model. Although the pathway to impact is much more obvious in a networked intelligence setting, the actual link between advice and policy change is ironically much harder to devise. The reason being that there is no guarantee, as an adviser, that you will know how your advice has shaped or influenced subsequent discussions; one might never know what they personally influenced. Even when the two models are combined, like with SAGE or the Gezondheidsraad (Health Council of the Netherlands) (see Bijker et al., 2009), the impact feedback might still not be strong⁷³. Overall, advisers' contributions tend to be more ad hoc, individualised, and influence is likely to be related to the ways the trusted experts perform and/or frame issues with political clout.

Like collective intelligence, networked intelligence is also influenced by factors that transcend the individual nodes of the network, but unlike collective intelligence, networked intelligence is judged largely on the quality of the network, not the quality of the knowledge products. From the perspective of science advisers, networked intelligence will nearly always be reactive and might only occasionally involve collaborative writing. Advisers can also be invited to peer review policy-facing documents, contribute writing, and/or collaborate on a piece of work with civil servants. Indeed, there was evidence of all of the above amongst my experienced interviewees. On top of this flexibility around advisers' roles, the networked intelligence model has many other benefits, such as relatively low costs and speediness, in comparison to the collective intelligence model.

The model also has well known shortcomings. For many material and cultural reasons, expert advisers' affiliations play an exaggerated role - leading to well-known biases in access and representation (e.g. the disproportionate representation of Oxbridge and Russell Group universities in UK science advice, mentioned by my interviewees). The same academics tend to be solicited over and over again. This can be seen in the media too, where the same small pool of experts gets quoted time and again (e.g. coverage of COVID-19). Parliamentary inquiries can be thought of in this way too; even though the inquiries themselves are technically open, the experts who are invited to give oral evidence are oft already part of the

⁷³ During COVID-19, not only did SAGE advise the GCSA and Chief Medical Officer - who would then sit on COBR (Cabinet Office Briefing Rooms) meetings where decisions were deliberated - but SAGE was mandated to exclude economic analysis from their advice, which was opaquely conducted by the Treasury (and other government agencies) instead. What is more, the Treasury had virtually no direct relationships or conversations with SAGE advisers (Sasse et al., 2020). This means that SAGE advisers were quite a few steps removed from final political decisions, despite being the main and most trusted source of science advice during the early stages of the crisis.

network. The same could be said for the heralded Chief Scientific Adviser system in the UK. CSAs are different to the extent that they are temporary civil servants, but they draw from internal and external networks to inform the Departments they work in, or Number 10 in the case of the GCSA.

Without group deliberations and because of its reliance on snowballing, the networked intelligence model has, in theory, fewer safeguards against group think⁷⁴. Just like with the collective intelligence model, it will depend on the diversity of perspectives and disciplines in the networks and/or being consulted. Diversity can be engineered deliberately, to a degree, by knowledge brokers like CSaP. However, that is much less likely to be possible in the case of informal, personal networks. In its most informal iterations, advisers' opportunities involve a lot of serendipity, especially when it comes to unexpected and disorienting encounters. When you add the importance of physical (and virtual) spaces for network-building and trust, it is easy to see how difficult it is for an observer to determine what conditions are likely to foster learning, and especially transformative learning.

Must the transformative learning come from a place of ignorance? Does it require an adviser to have not formulated a strong opinion prior to a meeting with a policymaker? Can learning about policy context directly from a civil servant be transformative? Does it require a certain kind of civil servant to create opportunities for such learning in the first place? From my limited case study analysis, I sincerely cannot answer these questions and more research would be required. In the figure and table that ensue, I summarise and compare the two models of science advice.

⁷⁴ Although there is also perhaps less emphasis on consensus than in the collective intelligence model.

Figure 8: Visualisation of networked and collective intelligence

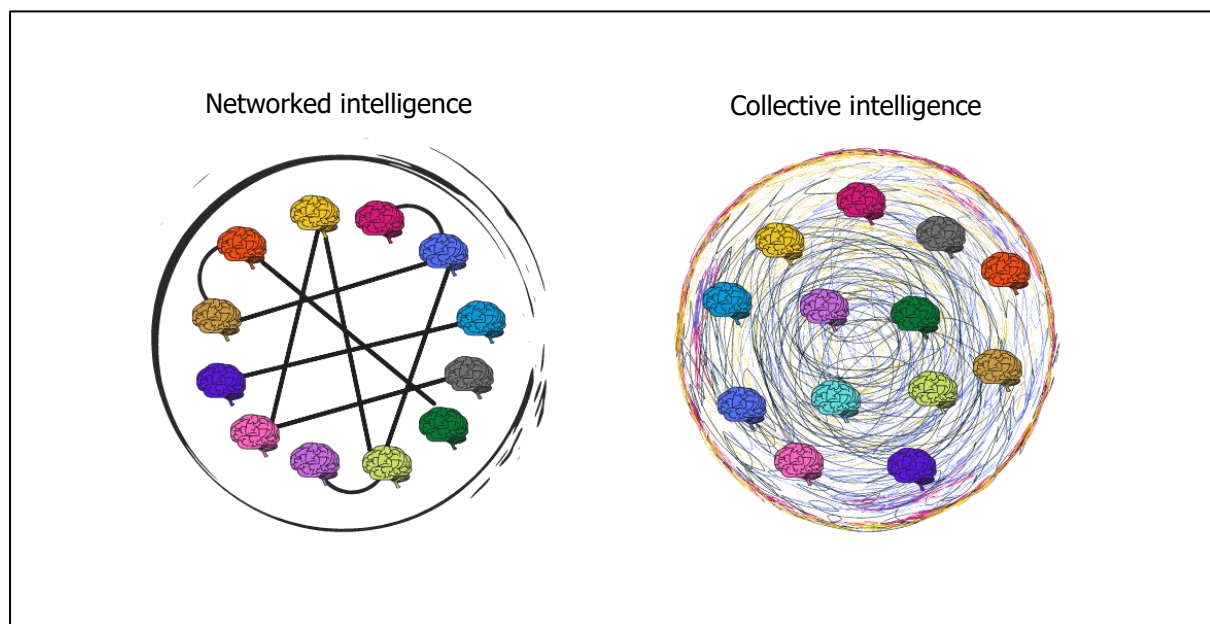


Table 6: A comparative overview of the two models

	Collective intelligence	Networked intelligence
In one sentence	<i>Whole is greater than the sum of its parts</i>	<i>Address book approach to science advice</i>
Found in...	• Scientific advisory committees • Policy-facing research organisations • Think tanks	• Some boundary and broker organisations • Personal diaries
Depends on...	• Quality of deliberations • Diversity of perspectives and expertise	• Individuals' qualities • Institutional and personal networks
Key determinants of success	• Influence of organisation • Organisational culture, including secretariat • Leadership (e.g. Chairs) • Interdisciplinarity • Independence	• Strength of networks • Effective brokerage • Snowballing • Trust • Personal influence
Products	• Communities of practice • Quality assurance on documents • Reports	• Private conversations • Relationships and collaborations • Short documents • Reading lists

Strengths	• Plays on academics' strength • Comprehensive appraisal of evidence base • Can prevent group think • Potential for representation of social sciences and humanities • Can be visionary/anticipatory • Can lead to considerable change (e.g. through reframing)	• Can be fast and reactive • Cheap • Discreet • Policy relevance is very clear • Immediate feedback • Potential for spill over into different policy areas (due to civil servant mobility)
Weaknesses	• Can be very slow and timing can be off • Costly • Policy relevance can be guesswork • Lack of feedback • Reports can easily be ignored	• Availability and selection bias • Potential group think • Partial expertise or coloured evidence base • Relies heavily on the interpersonal skills of advisers
Learning process	Situated learning in communities of practice; heavily influenced by the 'key determinants of success'	Mutual learning through direct exchange between advisers and policymakers. Highly variable and unpredictable.
Potential learning outcomes	• Science advice is akin to writing or reviewing papers • Independence is important • Science advice should be interdisciplinary • Science advice is mostly an exercise of synthesis	• Science advice is about good conversations • Science advice is about trusted relationships • Science advice requires the utmost discretion • Science advice is about persuasion

8 Discussion and conclusions

Throughout Chapters 5 to 7, I gave an account of the macro, micro and meso levels of the science adviser's learning journey - based on the *cultural encounter* model presented in Chapter 5. The three levels were: i) professional and national political cultures, ii) individual profiles, and iii) organisational cultures. For each level, I talked about both the *how* and the *what* of advisers' learning. The findings and analysis that emerged in these chapters were based on qualitative ethnographic and interview data, following a grounded theory approach. In this final chapter, I seek to: i) revisit and tie together the main highlights of my empirical analysis with an eye to lessons regarding 'impact'; ii) discuss the methodological limitations and innovations of the thesis, including the promise of diaries and simulations; and iii) present the implications of my work.

8.1 The art of impact

The time has come to talk about the elephant in the room: impact. At the risk of coming across as utilitarian, I see all science advisers' desire to learn - to improve their policy literacy - as being driven by the goal of maximising their influence. As we have seen, advisers have varied intrinsic and extrinsic motivations, often volunteering their time for little to no compensation (see Chapter 6), but the glaring sub-text is the hope that their advice will be heeded. Some individuals might engage with policy purely because of the academic impact agenda, but those individuals are likely to be outliers and their (institutionalised) objectives are nevertheless still about impact. Even advisers' normative preferences regarding the modes and models of science advice - for example, whether or not science advice is about information provision or advocacy - amount to disagreements over different paths towards the same destination.

Impact does however have different meanings for different actors in the science advice ecosystem. Research councils in the UK have their own understanding of policy impact, for example. I do not address these various definitions here - instead retaining the ambiguity of the term, which I argue is generative and part of advisers' learning (see Section 8.1.4). The picture of impact in science advice painted by my research participants was one of limited feedback, nonlinear change, serendipity, and sheer luck. By all accounts, impact is more of an 'art' than a 'science'. The art of impact can therefore serve as a heuristic to think about the different aspects of advisers' learning. It requires advisers to have the right cultural sensibilities (Chapter 5) and the right skills (Chapter 6) in and for the right environments (Chapter 7). In the ensuing sections, I bring together some of the empirical findings of this

thesis with the wider literature on science-policy and science advice. From my findings, I have identified and selected four fundamental (and high-level) lessons that most advisers must reckon with and the learning of which can be transformative. I use them as organising devices for the discussion, below.

8.1.1 Becoming bilingual

I'd love to see... more people understanding and being able to speak both languages. How does a civil servant ask a question that an academic can answer usefully? And how does an academic give an answer in a way that a civil servant can process? (experienced adviser).

I've always worked in incredibly interdisciplinary environments; I don't really know how to work in a single environment <h>. And I think that helps considerably, because I've always therefore had to listen to what someone else is saying and think: "what on earth do they mean?". And then also think about how I portray something and make sure that I'm portraying it in a way that they might understand. And so, language and learning the power of different languages is really important (experienced adviser).

It is the President of the International Network for Government Science Advice (INGSA), Professor Remi Quirion, who often says that we need to develop *bilingualism* in the scientific workforce (see I. Evans, 2021). By that, he means both French and English, and the languages spoken by scientists and policymakers respectively. This connects directly with the idea of literacy⁷⁵ and the *two cultures*. But in both the science and policy worlds, as we have seen, various languages are in fact spoken. Many of my interviewees talked about the multiple languages within science and the multilingualism required for interdisciplinarity. It was through science advisory environments that some of them learned to appreciate and speak the languages of social scientists, for example. This sort of scientific multilingualism can dampen the power dynamics and hierarchies existing amongst disciplines (as described by the social scientists I spoke to) and facilitate mutual learning.

For the *collective intelligence model of science advice*, I demonstrated that this bilingualism or multilingualism is essential for high-quality deliberation, inclusive of diverse perspectives. Moreover, the outputs of such deliberations tend to be useful when they are accessibly written, adequately disseminated, and well timed (see Owens, 2015) - which requires from science advisers that they understand the language of policymakers. From that perspective, we could extend the metaphor to say that a key learning objective for a science adviser would be to

⁷⁵ Both scientific and policy literacy. As I have said from the beginning, advisers' learning is in many ways about political and policy literacy. On that particular note, one experienced adviser told me with regards to scientific advisory committees that: 'there is no one sat around those tables who is not politically literate in some way'.

become a polyglot. Multilingualism is also related to the idea of the *T-shaped adviser* presented in Chapter 6.

Language is not only spoken, of course. A significant amount of the evidence I gathered around bilingualism had to do with writing skills and styles. Not only did research participants highlight the differences between scientific writing (e.g. academic journal articles) and advisory writing (e.g. reports), but also between the writing norms of civil servants and of scientists, in general. Former interns' accounts were particularly illuminating in that regard. In some instances, some of the writing skills in science seemed to be largely transferable, such as those associated with systematic literature reviews. In other instances, there were clear gaps, for example the ability of parliamentary staff to write impartially in a way which was 'second nature' for them - with one former intern recalling their realisation of just how subjective scientific writing was in comparison (a clear instance of transformative learning).

For science advisers to adopt policymakers' styles of writing takes a lot of *acculturation*, and may not in always be desirable. Firstly, interviewees pointed out that there are merits to scientific ways of thinking and communicating, which are sometimes overlooked or poorly incorporated into policymaking, especially around the communication of uncertainty and systems thinking. Secondly, the use of abstruse language can be an (unconscious) strategy to project expertise. As Dyer and Keller-Cohen (2016) suggest: 'the use of specific registers... is one means by which speakers display their expertise and/or power when dealing with clients. Power is thus seen to be located in the possession of knowledge and articulated partly through the use of this specialised lexicon' (p. 4). As demonstrated by the reluctance of Defra SAC and HSAC members to use excessively technical jargon (see Chapter 7), experienced advisers might nevertheless prefer to display humility and empathy in their communication style rather than flaunt their expertise.

But perhaps most importantly, bilingualism in the sense of policy literacy is not just about mastery of language, but also about appreciation of cultural differences. As I covered in Chapter 5, both the academic world and the policy world (especially the British Civil Service) can be conceived as a cultural groups in their own right⁷⁶. Understanding what makes these worlds distinct was a central point of *culture shock* and ergo (transformative) learning for some of my research participants. One of them told me about the importance of appreciating

⁷⁶ The languages spoken will, of course, also vary across national political cultures and *civic epistemologies* (Jasanoff, 2005a).

the differences between scientific research and science advice, saying that they used to be 'very naïve' about them.

A lack of appreciation or knowledge of these differences can lead to projections of the norms of science onto science advice, to the 'mini-me' problem⁷⁷ (Porter & Dessai, 2017), the deficit model of science communication (Gregory & Lock, 2008; Lawton, 2007; Scheufele, 2014; Walsh, 2013), or scientism (e.g. Blue, 2018) amongst others. In all three of these problems, and many others presented in the social studies of science literature, scientists often extrapolate their normative preferences onto the world of politics and policy. The perverse effects are well documented (e.g. the tragedy of climate science, see Howe, 2014) and the most experienced of my interviewees were well aware of the pitfalls of these unconscious biases.

It is through trial and error, and through personal experiences, that most advisers develop a more sophisticated and nuanced understanding of their audience. This sort of learning has been covered extensively in the fields of science communication and the public understanding of science (see D. V. Smith et al., 2016). In the case of science advice, cultural encounters (and especially intimate, face-to-face ones) are important for language acquisition; from learning acronyms to familiarisation with the organisational landscape and cultures at play. The languages spoken in those environments are mostly tacit, not codified in writing, and largely learned through acculturation or *empathic listening*. When it comes to impact, one anecdote stood out: a former CSA told me about their realisation that government economists 'wouldn't listen to the scientists partly because the scientists don't talk the same language' and that their own impact would be compromised if they could not find a way to bridge the linguistic divide. Overall, across institutional contexts, communications skills were highly valued amongst my research participants, and many of them stressed the importance of iterative learning in acquiring them.

Merely recognising difference is not enough; advisers must develop a certain degree of acceptance and *adaptability*. With regards to bilingualism and cultural differences, science advisers need to accept that professional norms and values can differ quite significantly (Douglas, 2008) and sometimes even directly contravene scientists' most sacred precepts. With enough patience and empathy, advisers learn to accept and understand why the professional norms around rigour and secrecy, for example, are necessary; they eventually

⁷⁷ The 'mini-me' problem refers to the erroneous expectations some experts have about their users; assuming that they think the same way, have the same interests and needs, and/or speak the same language. It is a reference to Dr. Evil's smaller clone in the Austin Powers movies. It is originally from Sofoulis (2011), but was adapted to government climate scientists by Porter and Dessai (2017).

recognise that time pressures are too great for academic standards of research and that some conversations are best kept out of the public eye. As we saw with the case of CSaP, displaying acknowledgment of these various political and time constraints was instrumental to building credibility and trust with the Policy Fellow. As anthropologists, sociologists, and linguists would readily recognise, for science advisers, language and culture are inextricably attached and should be treated as such.

8.1.2 Knowing your place

I haven't reflected on this to a great extent, on that sitting between. "Are you entirely an independent adviser?", "no", "are you completely tied down by the political voice, like I was when I was a special adviser in the House of Commons?", "no". You're sort of sitting in-between and that can be quite challenging for people... And I know that some members of [an] expert panel [I chaired]... did find this tension quite difficult because they were coming to it relatively new and they just wanted: "this is the independent advice, this is what I'm telling you, this is what the evidence shows". "Yeah, well that's fine but that's not going to cut the mustard sort of thing <h>" (experienced adviser).

Another important aspect of advisers' learning concerns 'knowing their place'. I do not invoke this idiom for its pejorative connotations (i.e. 'just do what you're told'), but rather for its reference to the 'limits' of advisers' agency and its situatedness. 'Knowing your place' is not only about the roles advisers undertake and/or are given (see Chapter 6), but also where they operate in the ecosystem of science advice (see Chapter 7). As I discussed in these two chapters, advisers' roles are far from static or even clearcut. They vary with the subject matters and organisational contexts advisers are enrolled into (Spruijt et al., 2014). Based on my analysis of Defra SAC and HSAC, they even seem to vary within a singular committee meeting. Experienced advisers clearly learn to make sense of various roles (or 'hats') an adviser might need to assume, albeit there was little evidence of this learning being transformative per se.

Over time, science advisers derive a sophisticated understanding of what they can do within the parameters they are given. As illustrated by the verbatim quote above, highly political environments such as a parliamentary select committees are particularly challenging in that regard (see Chapter 5 on the *party political culture*). In these instances, 'knowing your place' can be less figurative. One experienced adviser spoke about how, in the House of Commons, the specialist adviser sits 'right at the back' where it is impossible to 'get a note' to the MPs. Whereas in the House of Lords, the specialist adviser sits 'at the table with the Lords, next to the Chair'.

In the cases where one's 'place' is not so clearly designated, advisers' learning is complicated by the fluidity and oft tacit nature of their institutional and/or personal remits (see Chapters 6 and 7). The move from the '(perceived) demand for science' (Sarewitz & Pielke, 2007) to an accurate appraisal of the actual demand for science advice is ridden with trials along the way and depends largely on the levels of access or proximity to the policy agenda and cycle. Advisers must continuously figure out what kind of science or advice would be most useful in a given situation. Different types of scientific work can aid or service policy depending on the clients' wants and needs (e.g. 'regulatory science' in Jasanoff, 1994).

This was one of the threads I discussed in Chapter 7 - particularly around the distinction between *proactive advice* (e.g. horizon scanning) and *reactive advice* (e.g. peer review). As Jasanoff (1994) put it in her seminal book on science advice, 'protected by the umbrella of expertise, advisory committee members in fact are free to serve in widely divergent professional capacities: as technical consultants, as educators, as peer reviewers, as policy advocates, as mediators, and even as judges. Though their purpose is to address only technical issues, committee meetings therefore serve as forums where scientific as well as political conflicts can be simultaneously negotiated' (p. 237). This fuzziness is exacerbated when dealing with 'wicked problems', *post-normal science* (Funtowicz & Ravetz, 1993), and controversial topics.

In some instances, the *politicisation of science*⁷⁸ becomes so severe that advisory processes are no longer able to function properly (e.g. when basic independence or freedom of expression is compromised), because they have become hostage of big-P politics. As Mark Brown (2017) suggests, 'when people challenge existing procedures for science funding or expert advice, for example, they change those procedures from matters of routine administration into questions of politics' (p. 4). Although this is more likely to happen in science communication than in science advice, some advisers nonetheless have to learn how to deal with such situations⁷⁹. Advisers, including my research participants, are well aware of these risks (regardless of their level of experience) and try to mitigate them through different forms of *boundary work*. I found that - with experience - advisers' approach to boundary work

⁷⁸ To address the problems with the overgeneralising statement that 'all science is political', Brown (2015) defines the politicisation of science as: 'a process whereby people persistently and effectively challenge established practices and institutions, thus transforming them into sites or objects of politics' (p. 7).

⁷⁹ The politics of science during the early days of the COVID-19 pandemic was a case in point. Some advisers even received death threats and were bullied online (SAPEA, n.d.-a).

becomes more subtle and strategic, but boundary work does not disappear altogether. They learn when and how to draw and span it.

As a malleable concept, boundary work in science advice has been deployed and interpreted in a number of ways, most of which are in my view valid and useful (see Bijker et al., 2009; J. Boswell, 2018; Gieryn, 1983; Hilgartner, 2000; Jasanoff, 1994; Owens, 2015; Palmer et al., 2018; Turnpenny et al., 2013). Taken together, these researchers argue that boundary work involves the active and strategic demarcation of science from politics or policy, the negotiation of institutional responsibilities (including around cooperation), and the very transgression and spanning of those boundaries. As the EU's Group of Chief Scientific Advisers (2019) confirmed, boundaries are not only discursively drawn, they are also explicitly negotiated. And as Jasanoff (1994) concluded: 'the most politically successful examples of boundary work are those that leave some room for agencies and their advisers to negotiate the location and meaning of the boundaries' (p. 236).

From a learning perspective, an 'insufficiently permeable boundary between research and decision making risks that scientists set their research priorities by imagining what decision makers want to know rather than by learning from them what they actually need' (Clark et al., 2016, p. 4617). To better understand their clients' needs, science advisers must routinely cross the boundaries they themselves erect. It was precisely in this bridging activity that CSAs in Palmer et al.'s (2018) study saw their best chances of achieving impact. Palmer et al. (2018) present four different kinds of boundaries in science advice that are useful to relay here with regards to learning.

The first is the insider/outsider boundary, which I discussed at length in the case of the three cultures outlined in Chapter 5. The content and extent of an adviser's learning will depend largely on their proximity to the policy world (including the amount and duration of their *dwelling*); as interviewees pointed out, a CSA is far more of an insider than an arm's length adviser. The conferring or self-perception of an insider/outsider status has significant effects on an adviser's perceived role and remit, and ergo on the lessons learnt. The second boundary is similar to the first: the formal/informal boundary. This is largely about the behavioural and institutional aspects of advice. Experienced advisers learn to identify when it is or is not appropriate to behave informally. Depending on the sociomaterial circumstances and the forms of interaction between science advisers and policymakers, different degrees of formality and informality are permissible. For example, as argued in Chapter 7, informality can be associated with certain physical spaces such as the coffee machine or the pub. These spaces

are markedly informal spaces and are generally understood as such by all parties. They are, as Stephen Hilgartner (2000) suggested, *backstage* rather than *frontstage* spaces.

Frontstage/backstage is the third boundary proposed by Palmer et al. (2018). As with the insider/outsider and formal/informal boundaries, it has a lot to do with *stage management* and *information control*⁸⁰ (see Hilgartner, 2000). Hilgartner (2000) contends that science advisers' credibility hinges on their performance, of which boundary work practices are a part. An adviser's performance can be choreographed by a skilful Chair or scripted by a scientific advisory committee, for example, but will generally require learning when and how to improvise. The fourth and final boundary has largely to do with the level of collusion between science advisers and their policy counterparts. Palmer et al. (2018) distinguish between the 'delivery of evidence and "facts"' versus the 'co-construction of arguments and judgments' (p. 8). Here, and related to the discussion of *spaces of encounter*, they argue that 'both social and material factors are again imbricated in CSAs' efforts to bridge this final boundary, since the effective co-construction of arguments and judgements requires not only a distinct communicative approach... but also the physical proximity and time required to sit down and work through issues slowly and carefully, rather than through a series of briefer (or indeed remote) exchanges' (Palmer et al., 2018, p. 8). Former interns pointed out the importance of doing their internships in person for their immersion and (situated) learning - a luxury that my diary research participants did not have.

Finally, knowing your place does not only relate to the boundaries you should and should not transgress, but also the place of science in policymaking, in general. Perhaps the most unanimous lesson learnt by my research participants was that 'science is necessarily only one input into policy processes' (M. C. Evans & Cvitanovic, 2018, p. 4). Policy is not evidence-based, but can rather be evidence-informed. In his presidential address to the British Ecological Society, Sir John Lawton (2007) reflected on his learning journey. In particular, he addressed the widely held belief that if science is better communicated to politicians, then action will follow (i.e. the deficit model), saying that 'nothing could be further from the truth. Politicians have all kinds of reasons, some valid, some less valid, not to adopt what often seem to us to be common sense policies to protect the environment' (p. 465). In their own reflections, the former Chief Scientific Adviser for New Zealand, Sir Peter Gluckman, and colleagues reiterate that 'it is clear that the advice provided will always consider more than

⁸⁰ The active choices and work involved in controlling which pieces of information remain in the backstage and which ones are made available frontstage (Hilgartner, 2000).

scientific facts, and that policymaking does not necessarily privilege scientific input' (Gluckman et al., 2021, p. 85).

In an earlier article in *Nature*, Gluckman (2014) formulates it as the duty of science advisers to demonstrate the value of science, and not to assume its privileged status in decision-making. 'Science is one actor among many in the political system' (Weingart, 1999, p. 155). Experienced advisers recognise that scientific actors are one interest group amongst many. Some of the former interns, on the other hand, were surprised by the place that knowledge claims from interests groups occupied in Whitehall, at times being weighed on par with scientific knowledge inputs. 'Knowing your place', then, is about demonstrating knowledge and appreciation of all of the above. Doing so puts advisers in a better position to build trusted relationships with their policy counterparts.

8.1.3 Embracing nonlinearity

I think where it goes wrong is where people come in and think that there is a simple, linear relationship between people doing research and then policy being developed directly on it. That can happen, but it's really rare, and much more frequently, policy formation is a much more complex process [within] which natural science and social science evidence is [a] part, economic considerations are another part, and small p politics is rightfully another part. There are often incommensurate values or wishes from different stakeholder groups in a democracy, [and] it is up to Ministers, up to a politician to resolve (experienced adviser).

'The linear model exerts a strong hold on many scientists and policymakers as a model for thought and action' (Pielke, 2007, p. 77). Just like boundary work, there are benefits for both professional worlds to pretend or indeed believe in the linearity of change, although the benefits for policy officials remain slightly less clear to me⁸¹. Not only is there hardly ever a direct pipeline between scientific knowledge and political decision-making, but in the rare cases where there is, it does not guarantee that the impact can be discerned or measured. The very appeal of the linear model is that it offers a simplistic narrative in which policy outputs can be traced back to scientific inputs. But, as the former interns I interviewed observed, academic inputs are rarely credited (e.g. via citations) and most of the integration of science into policy design remains invisible to the outside world.

⁸¹ Some of the reasons I can think of include: i) to have the claim that their work is evidence-based or 'follows the science' as an option; ii) to draw on scientific evidence without having to explain which other knowledge and value inputs factor into decisions; and iii) to present policymaking as more analytical, controlled, and tidier than it actually is, given themselves more agency than they have in actuality.

For early-career researchers who have been socialised into strict citation practices, these sorts of cultural differences stand out, in ways which can be encouraging or discouraging for them. They were surprised and reassured to find more evidence-informed policy that they had initially expected, but their experiences also highlighted the inadequacy of academic metrics and norms around impact. One of the former interns even lambasted the absurdity of recommendations sections in biodiversity-related papers. Another suggested that for policy changes that did not attract public attention or that were relatively minor, there was a 'very rigorous' process for considering scientific evidence within Defra that could function largely undisturbed. Without exposure to the policy world, these sorts of realisations might never have happened - underlining the importance of *situated learning* and initiatives such as the UKRI Policy Internship scheme. Notwithstanding, the former policy interns struggled to go beyond basic tips (e.g. update website info, write better abstracts) when I asked them about what they might recommend to an academic peer who wants to have policy impact.

But even for those experienced advisers with the most exposure to the policy world under their belt (e.g. former CSAs), the ways in which science comes to bear on policy were never quite transparent nor systematic. Rather than proposing grand theories of change, experienced advisers were instead quick to mention the importance of luck. As one of the experienced advisers I spoke to told me: 'you realise that policymaking in the science area is a messy, iterative <h> and partly luck!' (see Chapter 6 for a lengthier discussion on luck and serendipity). In fact, one of the biggest lessons for advisers is precisely the messiness of policymaking. What science advisers find is a civil service that is hypermobile, with short attention spans and tight time pressures, and limited capacity to read the academic literature. Coming to terms with those constraints was a source of learning for virtually all of the research participants in my project.

It is partly because of the way Whitehall is governed that the linear model remains a pipe(line) dream. And perhaps partly because of social scientists' various attempts at devising neat typologies and frameworks of political decision-making, or the tendency of some scientists to think they can model the real world, many academics continue to expect predictable policy cycles and tractable policy levers. An experienced adviser suggested that reductionist scientists had the hardest time letting go of the notion of cause-and-effect in science-policy. This thought was supported by some limited evidence - in my project - of a correlation

between systems thinking in research⁸² (e.g. systems biology) and a rejection of the linear model.

Nonlinearity and the element of luck need not be totally disempowering though. Academics can become more skilled at advising, and therefore increase their chances of success, but they must accept that they have limited agency over: i) their opportunities to advise and ii) the impact of their advice. The former sentiment was quite strongly expressed by the experienced advisers I interviewed, for example with regards to planning a T-shaped career (see Chapter 6). On the latter, science advisers can prepare the ground for change, but engineering situations so that the stars align is incredibly difficult and unlikely. Some of my experienced advisers spoke about the importance of 'ignition events', which can bring advice to the fore. This is reminiscent of Kingdon's (1984) idea of *focusing events*. 'As Kingdon and many others have argued, the seeds of change can take a long time to come to fruition, and knowledge can lie dormant until shifting circumstances instil it with meaning and authority' (Owens, 2015, p. 42).

Although one cannot quite predict or prepare for such events, the background work needs to be ready if and for when they happen. For instance, an experienced adviser argued that writing advisory reports is still important, because they might become useful when the 'political stars are in alignment', even though it is definitely a 'long game'. Another experienced adviser claimed that if you get a focusing or ignition event without recommendations in place, you can end up with 'very bad laws'. This is an important point when it comes to pandemic preparedness, for example. Some of the former interns, and especially those who worked in parliamentary contexts, were surprised by the extent to which the political and policy agendas were shaped by the news and events of the day. Having one's workload radically change in a matter of hours is something that is generally alien to scientists.

Confronted with the lack of continuity, predictability, and feedback, less experienced advisers might easily feel discouraged by not seeing the fruits of their labour. If academic metrics are no good proxy (see Regan & Henchion, 2019), then what can advisers do to reassure themselves that their efforts are worthwhile? They can learn to recognise that impact has many forms.

8.1.4 Recognising impact's many shapes

I mean politicians are very busy as well, so if you do give them elements of language, they will start repeating them. And I have found this on multiple occasions, that I read about statements

⁸² The systems these researchers study are generally nonlinear.

that the Minister of this or that make and I recognise language that we have proposed in our committee. And we pay a lot of attention to these elements of language because there's this recognition... And although you can't trace exactly where it [all ends up] - it's not like going from A to B, like you can't trace exactly what you have influenced – you [can] certainly... [recognise a] pattern (experienced adviser).

The fourth and final lesson that I want to discuss is the fact that impact comes in different shapes and sizes. For example, Reed et al. (2014) sees three possible kinds of impact: '*conceptual* (raising awareness and changing beliefs or thinking), *instrumental* (direct changes to policy or practice) or *symbolic* (justifying existing policy or practice)' (p. 337, emphasis mine). With regards to typologies and concepts, the impact pie can frankly be sliced in any number of ways. What has already been established is that influence in science advice should be conceived as a spectrum or continuum from immediate responses to 'subtle, long-term conditioning of the policy environment' (Owens, 2015, p. 126). Owens (2015) speaks of 'atmospheric' impact in science advice.

That sort of long-term, indirect impact requires a lot of patience and perseverance, as well as *self-assurance* - a core trait identified in Chapter 6. As I discussed in that chapter, trust in one's recommendations but also in the integrity of the science advice ecosystem can help advisers build the requisite self-assurance. And that sort of trust comes with experience. A few experienced advisers also mentioned the importance of remaining optimistic, especially because advisers cannot always expect to have impact that will be 'benign' or in a direction to their liking (C. Boswell & Smith, 2017; Donovan, 2021; Owens, 2015). It would appear, then, that individuals with a growth mindset might be slightly at an advantage. And the sort of cynicism towards politics often found in the science world (see Chapter 5) might also therefore be unhelpful for a career in science advice.

As a case in point of the above, one experienced adviser told me that they were doing more work related to a report they had chaired ten years prior, than in the immediate aftermath of its publication. The principles of the report were still being considered and used in the drafting of the 25 Year Environment Plan. Like fine wine, some advisory reports age well. I argued in Chapter 7 that the best reports result from a well-executed collective intelligence model of science advice. And advisers can get some feedback, even when there is no legal obligation for the government to respond (e.g. with the CCC). As per the verbatim quote above, authors of advisory reports can sometimes recognise 'elements of language' in politicians' or policy officials' rhetoric that originate from their work.

Relatedly, one of the main threads I heard from my research participants across the board was the power of evidence synthesis in the policy space. Evidence synthesis is recognised as a key competence for science advisers by the European Commission's Joint Research Centre (see Schwendinger et al., 2022) and seen by experienced advisers as one of the most useful services they can provide to policymakers (e.g. Donnelly et al., 2018). In this mode of (indirect) advice, scientists synthesise the evidence base into reports or other information packages. This is the approach taken by Bill Sutherland and his team at Conversation Evidence⁸³, or indeed the philosophy of global environmental assessments such as the IPCC or the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Whether it is comprehensive synthesis or 'distillation' (see Tyler & Akerlof, 2019), these knowledge products can be a 'foundation of good scientific advice' (Group of Chief Scientific Advisors, 2019, p. 10). Former interns who delivered summary presentations on their research during their placement saw this as the single most tangible way for them to have an impact.

As with the collective intelligence model of science advice, 'high-quality synthesis requires careful selection of the disciplines and sources of expertise, rigorous quality assurance and challenge mechanisms, and intellectual independence, coupled with close engagement with the intended audience' (Craig, 2019, pp. 43–44). But as Craig (2019) also points out, the speed and rigour of synthesis will need to match the demand for it: 'evidence synthesis can happen in a matter of seconds in an expert's mind; in a matter of hours and days during a civil emergency; or over months or years in the case of reports by national academies [or scientific advisory committees]' (Craig, 2019, p. 43). Many of the experienced advisers I interviewed argued that synthesis should include clear communication on the known unknowns and the unknown unknowns, and this is well established in the academic literature (see Donnelly et al., 2018; Gluckman et al., 2021; Group of Chief Scientific Advisors, 2019; SAPEA, 2019). While advisers might never know the full extent of the uptake of such products, they can find some solace in the fact that if they are well designed and disseminated, they can be useful.

Finally, given the importance of personal and institutionalised networks in the science advice ecosystem (discussed in Chapter 7), a trusted relationship with a policymaker can be impactful in and of itself. That relationship can lead to future informal collaborations, sometimes in other subject areas, organisations, or at higher levels (depending on that policymaker's career progression). I have argued that networks are the focus of one of two dominant models in

⁸³ <https://www.conservationevidence.com/>

the UK, namely the *networked intelligence model of science advice*. As we saw with CSaP, not every conversation with a policymaker needs to be a eureka moment for both parties; what matters is getting yourself on their 'B list', as one interviewee put it. An academic can never know what sorts of opportunities that relationship might lead to down the line. Appreciating the importance of these relationships was a source of transformative learning for some of my research participants (across levels of experience).

My overall argument is that advisers who have taken in the four lessons discussed here are better equipped to influence. Yet most of that learning remains experiential, interrelational, situated, and tacit. So, what can we do to help early-career researchers and less experienced advisers? I present my recommendations in Section 8.3. Before that, I turn to the methodological limitations of the thesis (Section 8.2.1) and the results from my diary and simulation pilots (Sections 8.2.2 and 8.2.3)

8.2 Musings on methods

Back in Chapter 3, I discussed some of the (more theoretical) issues with the reliance on interviews and short-term ethnography to study advisers' learning. Here, I focus on what I have learned from the empirical analysis.

8.2.1 Methodological limitations of the thesis

First and foremost, there are issues of consistency with the nondirective interview. There were multiple occasions where I found myself being much more directive than I would have ideally wanted to be, either due to the interviewees' lack of engagement or reluctance to engage in (critical) self-reflection or because the conversations were - from my perspective - veering too far away from topics related to learning. While I was fearful that, in these cases, asking more direct and directive questions might prevent data on learning from emerging more organically, those few interviews where I nevertheless maintained a more nondirective approach did not generate high-quality data on learning in the end.

Across the board, the proportion of data collected that actually pertained directly and explicitly to learning represented only a small proportion of the swathes of information I got from my interviewees. This was the main reason I framed the thesis in the way that I did (i.e. an analysis of science advice as a system, interspersed with connections to learning). When we additionally consider the issue of *recollection* - mostly for experienced advisers - discussed in Chapter 3, then there are reasons to see the nondirective interview as imperfect. I would still however contend that in terms of access to learning and depth of conversations, the

nondirective interview would still outperform most other interview methods available to the qualitative researcher.

Secondly, and beyond the challenges presented by COVID-19 (i.e. the majority of meetings attended were virtual), the short-term ethnography had its limitations with regards to capturing in situ learning. It is likely that a more extensive, face-to-face ethnography would have yielded different results and judgements on the limitations of the method. The institutional ethnography I carried out nevertheless produced a lot of interesting insights on the organisational cultures and makeups of my three sites of study, as well as on the interactions between members and their discursive practices (e.g. boundary work), complementing the interview data from *unaffiliated advisers*⁸⁴. In terms of the chosen ethnographic methods, the annotation method used (based on Schatzman & Strauss, 1973) was very useful and worked well with my grounded theory approach. It allowed for ongoing reflection on the method itself, as well as the potential connections with the conceptual literature, and left a paper trail of my thinking on both. The *ethnography of meeting* guidelines developed by Brown et al. (2017) were incredibly useful for teasing out what - at first glance - might seem like banal data points, but which turned out to be some of the most pertinent manifestations of organisational culture.

When it came to learning, the follow-up interviews were quite effective and without them I would have had very little external validation. In other words, my conjectures on learning would be even more speculative than they currently are. Interviews seem like an obligatory passage point - even if it is just for checking assumptions and/or for external validation. And those interviews should remain as open as possible⁸⁵. Overall, whilst the ethnographic approach I took was broadly a success, I can safely assert that it should be supplemented by other qualitative methods such as interviews.

Thirdly, when it came to determining whether some of my data was indeed about learning, some speculations were necessary. Without crystal clear indications of a before and after state of affairs, I sometimes had to read between the lines. By the way an interviewee presented their thoughts, I would occasionally infer that the thoughts they were now conveying to me in the interview were new, or at the very least had evolved. Prior views might not have been

⁸⁴ Neither current nor former members or affiliates of the sites of study at the time of the study.

⁸⁵ A box ticking exercise will just reinforce the existing assumptions and framing formulated by the researcher. A researcher trying to access something as individualised and deep-seated as learning would need to let the research participants' own framing and mental models emerge, undisturbed by the observations of the ethnographer (especially conceptual and theoretical ones). Of course, the ethnographer can use some of their observations as prompts, but that should be as far as it goes in my view.

totally opposite (in fact, that is quite unlikely), but evolution rather than revolution can still be considered a learning process. In cases where the presence of learning was uncertain, however, such data points would never be coded as possible instances of transformative learning.

For teasing out transformative learning, the anecdotes approach was quite effective overall. There were nevertheless some examples of anecdotes that did not present clearcut evidence of transformation (including *straightforward transformation*). Examples included: a former CSA's story about the staggering speed at which information travels within Whitehall; an experienced adviser's story about a convincing talk given by an academic on useful datasets for decision-making; an experienced adviser's story about a poignant point made by one of their fellow committee members. While it was clear that learning had indeed occurred, and that these stories had stuck with them, it was less clear whether the learning had been transformative or not. These stories had become metaphors or metonymies for a particular lesson they had learnt, but indications of the processes of transformative learning as described by Mezirow (2000) were missing. Finally, the same could be said about the use of specific language cues (e.g. 'surprised', 'impressed') to detect transformative learning. While that worked in most cases, there were clearly also instances where it would have been too conjectural.

Fourthly, there were other limitations pertaining to the sampling strategy, as well as the geographical and subject matter focus of the research. With regards to sampling, research participants were selected based on publicly available information on their affiliations to advisory organisations, as well as snowballing (although that did not happen as often as initially hoped for). The reliance on CVs and publicly available information meant that advisers who had only engaged with policymakers informally were overlooked. Thankfully, most of the experienced advisers I spoke to had also advised in an informal capacity, but their perspectives were necessarily also shaped by their formal appointments. An even bigger caveat came from the focus on environmental and climate science advice. Whilst I had originally planned to tease out and discuss the differences between environmental issues and other science-related issues in the thesis, the coded data was not robust or interesting enough to merit its own section (certainly not when compared to the other codes).

Similarly, the focus on the UK came with some disadvantages. Although there was some data on other national political cultures (see Chapter 5), it was nowhere near a threshold that warranted a comparative discussion. The conjectures on Britishness and British national political culture were, themselves, only loosely supported by the evidence (in Chapters 5 and

7), and therefore any attempt to compare those observations with other national advisory contexts would have been too speculative for the empirical standards I was aiming to achieve. Furthermore, as with many studies on science advice (discussed in Salajan et al., 2020 for example), non-English literature and non-UK case studies were largely absent in my readings and analysis. It goes without saying that the generalisability of my findings must be considered with caution and determinations as to which parts apply to other science-policy issues and national contexts remain at the discretion of the reader.

8.2.2 Diary experiment

[The diary] got me thinking whilst I was in the actual placement. I kind of think about these things [normally], but it was really interesting to actually just take a moment to sort of write down what I was thinking and think about what I expected and how that changed with time (diary research participant).

Back in Chapter 4, I discussed the theoretical promise of diaries in the context of my research design, particularly given my emphasis on the situatedness (i.e. Lave & Wenger, 1991) of advisers' learning. Diary methods have proven to be very good at providing the researcher with greater access to thick descriptions of participants' inner experience and less recall bias than other qualitative methods, such as interviews (e.g. Furness & Garrud, 2010). However, since unstructured and semi-structured diaries can be of varying quality and/or useability, I supplemented them with nondirective interviews before and after the placements, so as to guide research participants' both in the writing of their diaries and in their reflections a posteriori. My experience from the diary exercise I carried out is that the combination of methods was, by and large, a success.

As a reminder: diary research methods were going to play a much more central role in the thesis, but with the various lockdowns in 2020 and 2021, it became increasingly clear that many applications for internships would be deferred until in-person opportunities returned (attesting to early-career researchers' instincts about the importance of the face-to-face experience for learning). I ended up with three participants, all of whom had to do their entire internships remotely. The three diaries were transcribed and coded (using the interview coding framework). Below, I offer my observations on the core strengths of the method, as well as some weaknesses that might either persist or be overcome with a larger pool of research participants.

The largely unstructured nature of the diary meant that research participants were relatively unconstrained in terms of the information they thought may or may not be relevant for me - generating some interesting entries that could then be asked about in the exit interview.

Unfortunately, one of the three research participants ended up using the diary as a research diary and consequentially the data was therefore far less useful or insightful than the other two⁸⁶. The vague guidance I gave research participants in the initial interview - on thinking about what surprised them, what they found challenging, and so on - nevertheless helped them to not stray away too far from writing entries related to learning. Overall, the diaries provided thicker descriptions than offered by the interviews with former interns, some of whom had finished their internship a year or more prior.

But it was the exit interview that proved to be the most consistent method for accessing participants' learning journeys. Before each exit interview, I would highlight specific entries in the transcribed diaries - which I thought were interesting - and I would then ask for clarifications or further reflections on those entries in the interview. In line with the overall success of 'mirroring back' in the nondirective interviews I conducted, the use of their own words as prompts was very effective for: i) contextualising and understanding some of their diary entries, ii) verifying that my interpretation of them was accurate, and iii) soliciting further thinking on those entries, with the added benefit of hindsight.

Perhaps unsurprisingly, if we take the diaries as a form of auto-ethnography, many of the shocks, surprises, and difficulties reported by research participants related to the cultural encounter - pretty much as described in Chapter 5. They mostly spoke (albeit in indirect ways) about the culture of the organisation they worked in, often relating it to and/or contrasting it with their experience in academia or elsewhere. It was interesting to see how much they had to say about culture despite the virtual nature of their internships, which testifies to the centrality of conversational exchange for acculturation in professional environments. Irrespective of their initial degree of surprise or difficulty in digesting some of these cultural traits, all three participants displayed some level of acceptance towards the end of the diary and/or in the exit interview. In addition, for two of the three participants, there is some evidence that the diary also helped them think about their own experience and learning during the placement.

My conclusion from this pilot is that, for researchers, diaries can be useful for studying policy placements and other types of prolonged stay in the policy world and, for practitioners, they can serve as a reflexive learning tool (both in situ and remote).

⁸⁶ Although it should be said that this was mostly due to the nature of their internship. They spent a large majority of their time working on a research project remotely, and did not engage much or spend much time with the policy teams.

8.2.3 Simulation experiment

The simulation exercise with Cambridge postgraduates (introduced in Chapter 4) was a success, from my dual perspective as the designer and facilitator of the simulation. Pedagogically, it was a success because it generated clear evidence of learning and the lessons learnt echoed the experiences of my interviewees and some of the academic literature too. And, methodologically, it provided a means of triangulation with - and validation of - my interview data findings. As expected - except for some cases of boundary work (e.g. 'another line of research which is not so scientific itself') and a couple of comments on a meta level (e.g. 'everybody thinks that their issue's the most important') - the data that came out of the simulation discussion was not particularly insightful.

Rather, it was during the subsequent twenty-minute debrief⁸⁷ that the most interesting data emerged. As Crookall (2010) explains, 'some learning often occurs while a game is being played, but deeper lessons are drawn out in a debriefing session' (p. 908). The results of the debrief attested to that and exceeded expectations. Some of them could be attributed directly to the design of the simulation, others less so. For instance, I suspect one of the determinants of success was the framing of - and participants' trust in - the simulation as a representative model of the real world, meaning that, in the debrief, participants focused on the bigger picture rather than simulation design per se.

A first learning point for participants was about time constraints. One said they had 'a new appreciation' for the length of time and effort it takes to formulate comprehensive science advice. Another said they were 'struck' by the lack of time to deliberate, by the lack of opportunities to come back on something said, and suggested that the short timeframes means that one might feel constrained to only comment on topics they really know about. For this participant, the exercise highlighted 'the importance of... brevity and accuracy' in science advice. Relatedly, participants routinely announced their lack of expertise on particular topics (just like science advisers in my sites of study). One claimed that you 'can't be an expert on everything' and so there is a tendency to assign less importance to the topics you are not knowledgeable about. Another said that they felt out of their depth during the deliberation, because their expertise was too narrow for such a broad brief (albeit that might have been more of a consequence of the simulation design than a significant learning point about science advice in general).

⁸⁷ I used the ORID (Objective, Reflective, Interpretive, Decisional) facilitation method to structure the debrief discussion (see ICA:UK, 2014).

The former sentiment relates to another learning point mentioned by different participants: a tendency towards a form of territorialism. One participant said that 'one thing [they] realised' was that they found themselves to be 'quite biased', prioritising the subject (or scientific research in this case) they cared about most. They added that it 'was 'really hard to... prioritise' and that those biases were 'very hard to recognise'. Another observed themselves and peers 'carve out [their] own specific interests' over time. All of the above contributed to the realisation, for some participants, that multi- and/or interdisciplinarity was necessary or at the very least desirable. One highlighted the importance of 'having a range of different... experiences within a committee', while another found that hearing a range of views from across the spectrum was a welcome change from the academic culture of ultra-specialisation. Yet another reflected that the exercise 'made [them] realise' just how valuable multidisciplinary is to 'make any kind of consensus decision'.

Finally, a handful of participants mentioned that the allocation part of the simulation (closing down) was much harder and more unpleasant than the horizon scan (opening up)⁸⁸. One tacitly acknowledged that science advisers need a diversity of skills (see Chapter 6) when they said that 'the first half was really enjoyable and inspiring, and the second half was a lot more difficult, more technical, [and] required a lot more thought and deliberation, I think. So, it's a very different skill'. The early-career researchers who took part in the simulation were regular attendees at talks and events on science-policy and science advice. They nevertheless still learned from the short simulation exercise. And some of the points they raised - around social dynamics on committees, for example - were the kinds of subtle and often tacit lessons that would have been lost on them in a PowerPoint presentation. Given these results, I join Selin et al. (2017) in their enthusiasm for role-play simulations as a pedagogical tool for teaching policy literacy.

8.3 Concluding remarks

Summary and implications of key findings

In this thesis, I have sought to answer the question: how and what do science advisers learn? Focusing on environmental science-policy in the UK - and using different qualitative methods - I analysed the macro, micro, and meso levels of an advisers' learning journey. In the analysis I presented: i) a model of advisers' learning based on the idea of the cultural encounter; ii) adviser profiles (i.e. skills and character traits) valued by peers and policymakers alike; and iii) two models of science advice with consequences for learning. I found instances of

⁸⁸ I am using Stirling's (2008) language as a shorthand here.

transformative learning (sometimes accounted for by culture shock) and plentiful evidence of situated learning in pretty much any advisory setting. Virtually all instantiations of situated learning - including in the diary research pilot - highlighted the importance of dwelling for *enculturation* in the professional and organisational policy cultures. Enculturation in the national political culture was also found to be important, with British cultural capital playing a role in fostering mutual understanding between scientists and policymakers in the UK.

One of the key aspects of an adviser's journey that my work highlights is the limits of individual agency with regards to both successful engagement and learning. Interviews spoke of the amount of sheer luck and serendipity involved. I observed, first hand, the importance of good mentors, leaders, facilitators, and convenors (e.g. Chairs and CSAs). I also observed the significance of sociomaterial circumstances, organisational cultures, and institutional epistemologies - in particular the attitudes of knowledge brokers and sponsors of science advice. The more reflexive these people and organisations are, the more they can encourage both individual and collective learning (see Borie et al., 2020, 2021; Pallett & Chilvers, 2015).

Thankfully, Chapter 6 also presented cause for optimism. Advisers can try to make their career T-shaped and develop sets of hard and soft skills that are highly valued in science-policy circles. They can get involved in inter- and trans-disciplinary projects, provided they can overcome the barriers and disincentives⁸⁹ to do so (see Hein et al., 2018 for an overview). Overall, while some of the skills and character traits I identified might well be innate (e.g. interpersonal skills and empathy), others can definitely be acquired with experience and training (e.g. communication skills and self-assurance). Advisers are clearly both 'born' and 'made'.

While I have spoken of the T-shape only with regards to the curriculum vitae and skillsets of skilful advisers, it is equally a useful metaphor to think through some of the bigger picture findings of the thesis. From a two cultures perspective, it mirrors the generalism that is ubiquitous in the British Civil Service (horizontal bar) and ultra-specialisation in academia (vertical bar). It also works well within the context of my two models of science advice. For collective intelligence, it conjoins the diversity of perspectives (horizontal bar) with the depth of deliberation (vertical bar). With networked intelligence, it captures the importance of the size of networks (horizontal bar) and the quality of relationships within them (vertical bar). The T-shape metaphor can even symbolise advisers' learning, which occurs through

⁸⁹ Interviewees mentioned the excessive focus on cognitive skills in universities and the fear amongst social scientists and humanities scholars of being used instrumentally by government as examples of barriers.

both/either breadth of experience across different parts of the ecosystem of science advice (horizontal bar) and/or depth of engagement within singular environments (vertical bar). As we have seen, while depth of engagement is necessary for integration into the policy culture and/or advisory organisations, breadth of experience - across diverse disciplinary perspectives and different modes and models of science advice - teaches advisers to work with various actors and adopt a more systemic and big-picture view of policy impact and its many shapes.

Recommendations for researchers

The thesis offers a novel methodological framework for using a combination of qualitative methods to study situated and transformative adult learning. It demonstrates how an interdisciplinary and deeply qualitative approach to adult learning can be designed and effected. It demonstrates that grounded theory and nondirective interviews - rather than deductive hypothesis testing, experimental psychology, questionnaires, and other quantitative methods - are a good fit with this research objective. The ethnographic approach I present can be used for empirical studies of organisations and their culture, with an eye to individuals' place and apprenticeship within them. Diaries can support longitudinal research on adult learning in science-policy and beyond, in particular in combination with other qualitative methods. Simulations can be used as triangulation or validation method. At scale, they might also serve as a an experimental - yet qualitative - method for studying situated learning. As for directions for future research, important knowledge gaps remain.

More intensive research into singular sites of learning or more systematic comparisons between sites could further our understanding of the relationships between ecosystems of science advice and their inhabitants - especially if extended beyond the UK or the environmental focus of this thesis. In Chapter 6, I discussed the hypothesis that some disciplinary skills might be more closely aligned with advisory skills than others. Counter-intuitively, I found no evidence of applied research being more compatible with - or better preparing academics for - science-policy activities than blue skies research. Further research on the effects of disciplinary training on advisers' performance and learning, would be both interesting and worthwhile.

Recommendations for science-policy practitioners

I can see several ways in which this thesis - and especially digestible knowledge products that could be derived from it - can be useful for aspiring science advisers and science-policy professionals. For early-career researchers, it brings together, in one place, years of lessons learnt by senior science advisers - providing a repository of guidance, tips and warning signs

to draw on. Readers already engaged in science advice might find comfort in the corroboration that many of their frustrations and experiences are shared and/or widespread (Table 4 on cultural differences might be particularly helpful in that regard), and they can reflect on their own learning journey in the process.

The thesis also provides useful heuristics for knowledge brokers and educators. The models of science advice have clear and important repercussions on the design of meetings and science-policy institutions. Table 6, in particular, could be of use to existing and nascent boundary organisations seeking to define their purpose, strategy (including a theory of change and value proposition), and organisational culture. In general the findings of the thesis could help practitioners be more cognisant and targeted in their efforts to influence policy and to grow in their effectiveness as advisors. From a pedagogical perspective, the resounding success of the pilot simulation of an advisory committee points to the revolutionary potential of empirically-informed simulations - and gamification in general - in science-policy education. To encourage reflexive learning, diaries are promising too. For instance, they could replace traditional reporting formats in the design of policy placements and secondment schemes.

Overall, this thesis has provided preliminary answers to the questions posited at the beginning of the study, whilst also prompting new ones. In doing so, it has equally offered workable, practical ideas on how we can better prepare the next generation of science advisers.

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Appendix A: Final coding framework for the interviews (header codes and subcodes)

- Positions held
 - Science for policy
 - Policy for science
 - Policy internships
- UKRI Internships
- Motivations to advise / intern
 - Apply research beyond science
 - EBP / sound science for policy
 - Exploring career options
 - Have an impact / fix smthg
 - Incentives
 - Learn about sci-pol
 - Political / interest in politics
 - Sense of duty or responsibility
 - Stimulating and interesting
- Getting into policy work
 - Policy-relevant work / research
 - Disciplinary training
 - Luck / serendipity
 - Personal traits & skillsets
 - Political context
- The two cultures?
 - Culture of politics
 - Culture of science
 - Culture of policymaking
- The different kinds of advice
 - Advice vs advocacy
 - Advice as network
 - Advice as reports/documents
 - Formal vs informal
 - In a crisis, urgency
 - Reactive vs proactive

- The roles of scientific adviser
 - As reviewer
 - As convenor
 - As information provider
 - As org change consultant
 - As translator
 - Description of the role
 - Navigating multiple interests
- Science-policy (general)
 - Accountability / responsibility
 - Defining evidence
 - Independence & impartiality
 - Influence / impact
 - Interfaces
 - National political culture
 - Timing and timescales
 - Transparency / open science
 - Trust
- Environmental issues
- Organisational stuff
 - Information on orgs
 - Composition of members
 - Resources (inc Secretariat)
 - Role of the Chairperson
 - Spatial & sociomaterial
 - CSaP
 - Defra
 - Defra SAC
- Learning
 - Impersonal comments
 - Marginal learning
 - Transformative learning
 - Situated learning
- Normative statements
- Advice to younger self

- Use of humour
- Good nondirective questions
- Misc
 - Personal experience/reflections
 - Possibly useful info
 - Suggestions for my research

Appendix B: Interview prompts (initial version)

Legend	
Experienced adviser ¹	Orange
Unexperienced adviser ²	Blue
Adviser with affiliation ³	Green

N.B. the categories of *experienced adviser* and *unexperienced adviser* should remain flexible. If, as the interview progresses, it comes to my attention that someone who might be categorised as unexperienced based on their curriculum vitae is in fact quite experienced, the prompts should be adapted accordingly. The opposite is unlikely to happen.

Orange	Blue	Green	Unexpected aspects of policy world
Orange	Blue	Green	Idea of science advice - changed overtime?
Orange	Blue	Green	Good versus bad advice - responsibility?
Orange	Blue	Green	Place of most important conversations
Orange	Blue	Green	Influence of reports/documents
Orange	Blue	Green	Changed your mind in advisory setting? Reasons?
Orange	Blue	Green	Difficult moment - emphasis on resolution
Orange	Blue	Green	Memorable anecdote
Orange	Blue	Green	Questions I should have asked?
Orange	Blue		Most successful ways of advising
Orange			Advice to younger self / do anything differently?
Orange			Importance of networks
	Blue		Hardest part? Disappointed?
	Blue		Compromises / constraints
		Green	Sense of belonging?
		Green	Organisational culture?
		Green	Meeting-specific questions (based on ethnography)

¹ Refers to those individuals who have extensive and/or in-depth experience in different advisory roles in the UK; defined here as at least two different appointments and/or several years within a single, prominent advisory role. Experienced should also understood as depth and type of engagement with specific advisory processes (e.g. Chairs will have a different experience). They may or may not be affiliated with the selected sites of study.

² Refers to those individuals who are either i) relatively new in their roles as advisers (recently appointed with no prior appointments) or ii) early-career researchers with limited prior encounters with the policy world (no more than two short-term appointments or one placement in government or parliament).

³ Refers exclusively to those individuals who are either current or former members/affiliates of the selected sites of study.

Appendix C: Letter of invitation to interview



Noam Obermeister

PhD Student, Department of Geography

Supervisor: Professor Mike Hulme

DATE

NAME

ADDRESS

Dear *NAME*,

I am a PhD student working with Professor Mike Hulme at the University of Cambridge. I am getting in touch because I would like, if possible, to interview you for my PhD on science advice.

The aim of the research is to understand the experiences and personal journeys of scientific advisers, particularly in relation to climate and other environmental issues. Interviews are an essential part of my research project and I will be interviewing both experienced and early-career expert advisers. In addition to the PhD thesis, I am looking to develop digestible, concrete guidance for early-career researchers wishing to engage with policy.

If you agree to an interview, we would have a conversation about some of your experiences, reflections, and recommendations with regards to advising decision makers, in the UK context (and beyond, if relevant). Ideally, interviews would be conducted in person but, if necessary, could take place remotely via Skype.

Interviews will be recorded, transcribed, and will run for about 45 minutes to 1 hour. In the email, I have also attached an informed consent form, which further outlines how I intend to ensure the anonymity, confidentiality, and security of your data (in line with GDPR). I will require that the form be signed by both parties ahead of the interview.

I appreciate that you must be extremely busy, but very much hope that you will feel able and willing to participate. Please do not hesitate to email or call me if you have any questions or concerns.

I very much look forward to hearing from you.

Yours sincerely,
Noam Obermeister

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University of Cambridge
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SIGNATURE

Appendix D: Nondirective interview pilot study

In order to test the nondirective interview method, a pilot study was undertaken in April/May 2019. Methodological reflections emerging from the pilot study are presented below. They were taken from my first year report and only lightly edited.

I interviewed an early-career researcher (Interviewee A) and a well-established, experienced academic (Interviewee B) from the University of Cambridge. Both of them currently work on issues related to the environment. Their identities will remain anonymous as per our agreement. For both interviews the initial version of the interview prompts was used (i.e. Appendix A). The interviews lasted about forty-five minutes each. They were recorded and transcribed, but not coded or analysed in any depth. Instead, here, I offer some reflections on my performance as an interviewer - taking into consideration the method of the nondirective interview.

In both interviews I asked a mix of nondirective, directive, and clarification questions. The directive questions were mostly asked when answers from the interviewees reached 'dead ends'. Interviewee B was particularly challenging, because they provided short and crisp answers and I very much struggled to set them off on monologues. There were too many directive questions in the overall mix and that was partly due to my discomfort sitting with silence, as well as a fear that the interviewees might want to end the interview or disconnect if I stopped engaging them. Asking purposefully naïve questions was particularly successful with Interviewee A. Conversely, it went poorly when I imposed or revealed my theoretical and political assumptions. For example, with Interviewee A, I suggested that expert solicitation can serve to legitimise certain political actions. They thought it was cynical:

That's the established cynical view. I don't think that's true. I think that's unfair, again, on policymakers. You're using 'legitimise' instead of 'inform', because you're trying to suggest that policymakers are hiding behind research.

While the response does reveal some interesting aspects of the interviewee's position, it also negatively affects my neutrality and credibility. Overall, in future interviews, I need to make sure that I consistently use the interviewees' terminology, not mine. Finally, I could not get some critical self-reflection out of Interviewee B who mostly talked about getting better at convening and structuring meetings or reports. There was virtually no admission of challenges or failures. I need to be prepared to the eventuality that it might happen again with some of the experienced advisers, especially.

Appendix E: Ethnography approach refresh (with the most important elements in bold)

Top lines

- ❖ Ethnography is a process not a product
- ❖ 'Complete participants' vs 'complete observers' & 'participants as observers' vs 'observers as participants'
- ❖ **Nothing too banal, too mundane – 'constant problematisation'**
- ❖ Not just about immersion but also translation
- ❖ Must become an 'acceptable incompetent', not an 'ignorant spy'
- ❖ Short-term engagements can benefit from intensity, empathy, and ongoing 'ethnographic-analytical-theoretical dialog' (Pink & Morgan, 2013, p. 353)
- ❖ Fieldnotes can include personal reflections and reactions in the moment - although consider the differences between asides, commentaries and in-process memos
- ❖ **Inscription versus transcription (probably mostly inscription – make clear with the use of ~)**
- ❖ Reminder: 'subjects in elite positions have good reason to be disarmingly indifferent to ethnographic research' (Katz, 1997, p. 402)
- ❖ **Bottom-line: need an 'approximate strategy' but notetaking mostly 'improvisational' and iterative**

Actions during

- ❖ Avoid talking with 'a realist voice'; use first-person
- ❖ **Use Schatzman and Strauss (1973) method: theoretical notes (TN), observational notes (ON) and methodological notes (MN)**
- ❖ Record (socio-)material circumstances of the meeting (e.g. through sketching)
- ❖ Focus on tacit knowledge / 'knowledge in action'
- ❖ Look for and note 'the oscillation between personal and role perspectives, the micro-dynamics of meeting interactions between persons but also within them' (H. Brown et al., 2017, p. 19)
- ❖ Pay attention to documents; how and when research participants refer to them

- ❖ Relate what I'm seeing to what I've heard in the interviews (and elsewhere) & think about the similarities across the various meetings (*do they conform to an archetype and/or to a practice?*)
- ❖ **Take note of use of humour (with <h>)**
- ❖ Think about 'how relationships "within" these spaces are linked to transformations beyond them, including of institutional structure, time, space, and society' (Brown et al., 2017, p. 15)
- ❖ Work to maintain a consistent self-representation in your field site
- ❖ **Draw glasses  for things to look into**

After

- ❖ **Transcribe physical notes digitally as soon as possible**
- ❖ Reminder: fieldnotes are descriptive, selective, and often incoherent accounts of what is happening in the field
- ❖ In the grounded theory approach, ethnographers qualitatively code and analyse the fieldnotes as a corpus of primary data
- ❖ Reflexivity increases the trustworthiness of the ethnographer's research
- ❖ Record the pragmatic considerations and restraints of the ethnography (lived and expected)

Based on and/or inspired from: (H. Brown et al., 2017; Ciuk et al., 2018; Emerson et al., 2001; Ievins, 2019; Katz, 1997; Pink & Morgan, 2013; Sanchez, 2019; Shankar et al., 2017; V. Smith, 2001)

Appendix F: Consent form

Researcher: Noam Obermeister, PhD candidate

Affiliation: Department of Geography, University of Cambridge

Purpose of research: Doctoral thesis

Supervisor: Professor Mike Hulme

Contact: [REDACTED]

My mobile number

I voluntarily agree to participate in this research study.

I agree to my interview being recorded and transcribed. I understand that I can subsequently request a copy of the transcript.

Under the General Data Protection Regulation (GDPR), I am aware that I can request to correct or erase any data held on me.

I reserve the right to withhold any sensitive information and can, at any time, refuse to answer any question or stop the interview.

I understand that all information I provide for this study will be treated confidentially and not shared with any third party.

I understand that anonymised extracts from my interview may be directly quoted in the final thesis or published paper(s).

I understand that in any report on the results of this research my identity will remain anonymous. This will be done by removing any and all individually identifiable information from the interview transcripts, including details of my interview which may reveal my identity or the identity of people I mention.

I understand that the signed consent form, the original audio recording, and the transcript of my interview will be deleted 2 years after the award of the doctoral thesis.

I have been informed that the recording, transcript, and any other personal data held on me will be stored in an encrypted folder.

I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.

I understand that I will not benefit directly from participating in this research.

.....

Signature of participant

Date

I believe the participant is giving informed consent to participate in this study

.....

Signature of researcher

Date

Appendix G: Information sheet for potential diary research participants

If you're planning on doing a **policy placement in relation to environmental issues or climate change**, then you might be able to help me out with my PhD research.

I am a 2nd year PhD Student, in Geography, at the University of Cambridge. My research is on environmental science advice to the British government. I'm really interested in the experiences and journeys of early-career researchers who spend some time in government departments or policy organisations dealing with environmental issues (e.g. Defra, BEIS, FSA, Natural England). Aside from the academic necessities (i.e. the thesis), I'm hoping that my research can inform researchers who want to have an impact on policy. To that effect, part of my research involves talking to very experienced scientific advisers, including a few former Chief Scientific Advisers.

What would your participation involve?

The easy part: I would interview you before you start your placement. We would then do another interview after you've finished the placement. These interviews run for about 45 minutes to 1 hour.

The other part: I would ask you to keep a diary during your placement. That wouldn't involve more than writing or recording (in the case of audio) an entry about your experiences every now and then. We would discuss beforehand what format, frequency, and content you feel most comfortable with.

I should say that I have a strict protocol for assuring the anonymity, confidentiality, and security of your data (in line with GDPR). I should also say that this would be on a volunteering basis; I'm afraid I don't have any funds for compensating your time.

I do hope you're willing to take part!

If you are interested, just drop me a short email [REDACTED] and we can take it from there.

Many thanks.

Noam Obermeister

Appendix H: Email advertising and framing the advisory committee simulation



Event Highlight

Science Advisory Committee Simulation



Science Advisory Committee Simulation

Session run by Noam Obermeister

Always wondered what it would be like to sit on a scientific advisory committee? Now you can find out! CUSPE will be hosting a science advisory committee simulation as the first workshop of

Lent term. This workshop will be centered on an interactive simulation exercise in which participants will act as members of a fictional science advisory committee -- chaired by Noam -- within GO Science, the Government Office for Science. On the day of the workshop, participants will be given a scenario and will have approximately 1 hour to come up with recommendations for "the Minister". The simulation will be followed by a debrief and a short Q&A with Noam.

The workshop is a collaboration between Noam and the CUSPE Workshops team and is based on Noam's observations of Defra SAC meetings, a high-level Science Advisory Council within the Department for Environment, Food and Rural Affairs. Interested participants should sign up [here](#).

About Noam

Noam is a 3rd year PhD student in the Department of Geography, at the University of Cambridge, and a facilitator in the making. His main areas of interest are in science-policy, environmental and climate politics, the history and sociology of science, bioethics and science communication. His PhD project focuses on the experiences of academics who have advised and/or currently advise the UK government on issues related to the environment and climate change. He is interested in both the experiences of very experienced advisers (e.g. former Chief Scientific Advisers) and of early-career researchers at the beginning of their journey engaging with policy (e.g. through UKRI internships). Aside from the academic necessities (i.e. the thesis), he hopes that his research can inform researchers who want to have an impact on policy. His academic background is in political science (BA) and human geography (MSc).

Please note: On the sign-up sheet interested members can indicate whether they prefer to be a participant of the simulation or an observer. If you would like to participate as a member of the council, you'll be asked to provide a short description of your background and motivation, so we can put together a diverse committee. Priority will be given to post-grads who are actively involved in research. The event will be capped at 8 participants and 17 observers, although we will run a second simulation if there is sufficient interest. The exact topic of the simulation will be distributed during the workshop.

Noam will be drawing on the simulation exercise for his PhD research. Signing up for the workshop will be taken as consent for the simulation to be used for research purposes. The session will be recorded and transcribed by a trusted third-party service (see: <https://takenote.co/>). Noam follows a strict protocol of confidentiality, anonymity, and security of your data (in line with University guidance and GDPR). Feel free to get in touch with Noam if you have questions or concerns about any of the above [REDACTED].

Date: **Thursday 4th February**

Time: **5 - 7 pm**

Appendix I: The simulation brief read out loud to participants

Following the Government's Spending Review, the Chancellor - Rishi Sunak - announced that the Government would provide £14.6 billion in R&D funding for 2021-2022 and has plans to increase that number to £22 billion per year by 2024/2025.

The Government Office for Science (GO Science) is considering earmarking some of that money to fund science & technology research on the most pressing issues that the UK is likely to face by 2030. Colleagues at GO Science approached our Secretariat last week and have asked if we could provide some recommendations on what we think those issues might be and some initial thoughts on how to allocate the earmarked funding. The Secretariat has advised us to work on the assumption of ~£2 billion per year.

I should also say that I had a brief chat with Sir Patrick Vallance (the Government's Chief Scientific Adviser) this morning who alluded to the fact that N*10 wants a significant portion of that money to go to British industrial partners and it's my sense that N*10 expects the R&D to yield considerable returns on investment. Of course, we are free to make whatever recommendations we judge best but I mention this because I think we probably ought to bear it in mind in today's discussions.

My interpretation of the brief is that we should start with a quick horizon scan on emerging issues by 2030 and then move onto some preliminary thoughts on how to allocate the ~2 billion. We're very limited on time, so please forgive me if I'm strict on timekeeping. Any objections or thoughts before we kick off?