Under what conditions is science considered relevant and authoritative in policymaking?

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Abstract: Questions about the role of science in decision-making have come into sharp focus since the Covid-19 pandemic. Perceptions about science and decision-making vary widely amongst the public, and amongst scientific and policy communities themselves. What then can be done to create conditions which support greater trust in science in decision-making? Unpacking these factors helps us to understand how evidence is framed as both relevant and authoritative. In this report, we draw on an evidence synthesis, three case studies, a social media analysis and a series of workshops to explore the conditions which lead to science being considered relevant and authoritative in and for policymaking. We find that policymakers can influence the role of science in the way that they approach or present problems. However, members of the public may or may not be influenced by the ways policymakers choose to frame issues and will bring their own beliefs and values which influences what evidence they consider relevant. We find that use of science does not, in itself, increase trust in policy. Rather, people trust institutes, leaders, and processes which are seen to be competent, honest and fair. Focusing on how to build trustworthiness through these three domains is likely to be the most fruitful approach for scientists and policymakers wishing to increase trust in both science and policy.

Acknowledgements: We gratefully acknowledge the contributions and suggestions made by:

- Giulia Cuccato, who conducted interviews and helped write the report
- Sense about Science, who led user-testing workshops exploring how different audiences respond to scientific data and information;
- UCL STEaPP students, who developed materials for the workshops
- Myrtle Ziwei Zeng, University of Sheffield for her research assistance with the social media analyses
- Professor Jo Chataway of UCL STEaPP, who offered constructive guidance and support.
- We also thank two anonymous peer reviewers and a proof-reader whose contributions strengthened and clarified this report.

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Executive summary

Questions about the role of science in decision-making have come into sharp focus since the Covid-19 pandemic. Perceptions about science and decision-making vary widely amongst the public, and amongst scientific and policy communities themselves. While debates about what types of evidence should inform policymaking often focus on research methods, political science and philosophy tell us that the perceived salience, credibility, and legitimacy of evidence determine whether it is used (Cash *et al.*, 2003a). People's beliefs and values shape how they identify problems, relevant evidence, and potential solutions. What then can be done to create conditions which support greater trust in science in decision-making? Unpacking these factors helps us to understand how evidence is framed as both relevant and authoritative. In this report, we bring together insights from a synthesis of the literature and major policy reports about trust in science, trustworthiness, and the relationships between science, policy, and publics to address the questions:

- *Under what conditions is science considered relevant and authoritative in policymaking?*
- *Which factors influence why particular policy issues are seen (by the media and by publics) as requiring scientific evidence to underpin decisions?*
- *What types of scientific claims have most traction and ability to elicit trust?*

A common—although becoming rarer—belief amongst scientists is that building greater awareness of science and increasing scientific literacy amongst the public (often called 'public understanding of science') would increase support for scientific claims and related policy action. More recently has come a realisation that science and scientists are also shaped by values and beliefs; leading to the 'public engagement with science' approach which seeks to generate shared understanding and improved dialogue around issues to which scientific research and advice are relevant (Gregory & Lock, 2008). This report focuses primarily on this latter situation, seeking to understand how publics respond to scientific advice offered in the service of policymaking, drawing in insights about generalised attitudes to science, and from the literature on how evidence is perceived and used in public and political debate.

Science advice here is understood to be the delivery of scientific expertise from across the research disciplines, via a range of mechanisms, including advisory committees, boards, and specific roles within government (Gundersen & Holst, 2022)

The wider literature about how publics are formed by, respond to, and engage with scientific discourse is drawn on, but not comprehensively summarised in this report.

An evidence synthesis

The initial phase of the project brought together existing reports, survey data, and existing published research evidence. Data were extracted about key factors which influence trust in science-informed decision-making, including the nature of the policy problem, the nature of the evidence base, the message and messenger, and the relationship between publics, scientists, and government.

Comparative case studies

The next phase explored how these factors play out in three contrasting cases: Clean Air Zones, GM crops (in particular precision-breeding), and Monkeypox. For each case, we developed a timeline which documented major publications (e.g. from funders, government, or major activist organisations), critical events, and media reports. We conducted semi-structured interviews to gather perspectives on the role of science, trust, and the media in determining how the policy was developed, implemented, and received by the public. We looked at the major discourses and opinion leaders around each case, using cutting-edge digital methods to analyse social

media data. This involved identifying major scientific commentators around each case, collecting information about their social media profiles, content, and followers.

User-testing workshops

Finally, led by Sense about Science, three workshops with members of the public explored different data visualisations. The materials for the workshops were co-developed with students from University College London (UCL). The aim of the workshops was to find out how participants responded to different formats and presentation styles and what were their preferences in communicating the evidence behind policies in a clear, convincing, and authoritative way.

This report is arranged as follows. The methods used to gather information through evidence synthesis, interviews, and experiments are described. Next, key messages are discussed with reference to the synthesis, case-study, and experimental data as appropriate. Finally, there is a short conclusion which discussed these key messages, and draws out implications for government, scientists, and other stakeholders. In-depth reports on the elements of the report (evidence synthesis, case studies, social media analysis and user-testing workshops) are available online at Transforming Evidence[1].

[1] https://transforming-evidence.org/projects/science-trust-and-policymaking

Key messages

1. Policymakers approach problems in different ways, which make it more or less likely for science and scientists to have an obvious and explicit role or voice.
2. The way people view issues may or may not be influenced by the way policymakers frame them.
3. Use of science by itself does not make policy more trusted.
4. Trustworthy institutions, people, and processes are those seen to be competent, honest, and responsible.
5. Instead of placing the responsibility on publics to become more trusting, science and policy systems should seek to become more trustworthy.

Introduction

Many people agree that science should form the basis of effective policymaking. Yet the relationship between science and policy is not straightforward. 'Science' itself can be interpreted as a body of knowledge produced over time, but it is also a profession, an industry, and a way of thinking. Designating a particular piece of information as 'scientific' does not in itself explain where it came from, or confer a sense of authority and truth (Bijker *et al.*, 2009). As philosophers of science have argued for many years, the scientific process is often understood to be about *disproving* ideas, as well as establishing consensus (Popper, 1963). In fact, science is about understanding problems and phenomena, measuring, configuring what is known into patterns, and exploring new ideas. Within the scientific community, there is a great diversity of approaches and ideas, about which there is often less than universal consensus. Our ideas about what constitutes facts change over time, and the scientific communities who produce evidence, known as 'epistemic communities', form and re-form as our methods, technologies, and values shift and evolve (Dunlop, 2014).

If science is known to be peopled by a broad and diverse community involved in disputation, then so too is the world of policy and politics, which is characterised by struggle and disputation (Mouffe, 2000). No less than in science, policy is a site of conflict between ideas—ideas about actions, beliefs about priorities, and ways of working. How, then, should the relationship between science and policy, these two great arenas of debate and challenge, be characterised?

The plethora of frameworks and models put forward to help us understand this relationship indicates that this is a complex and plural set of connections. There is more than one type of evidence considered important in decision-making; 'evidence' includes scientific knowledge—natural and social sciences, as well as humanities and arts—and also public views, professional interests, industrial activities, and more (Head, 2008; Pawson *et al.*, 2003; Ritter *et al.*, 2018). These knowledges may be drawn on by decision-makers through a myriad of mechanisms, some intentional and others serendipitous; ranging from the formal 'science advisory system' to the chance encounter. Knowledge may be used in different ways: answering questions, solving problems, framing solutions; to strengthen an argument or undermine an opponent; to persuade or confirm; to surprise or alarm. Individuals or organisations may attach interpretations to knowledge, often called making scientific 'claims' (Douglas, 2023).

Each of these situations will be responded to differently by observers. The public is a heterogenous community with individual histories which have shaped their own beliefs and values. People will hear the same piece of evidence presented in the same way by the same actor and yet react differently because of these individual histories. Some might respond positively to a leader making strong judgements and attaching these to scientific claims. Others will react more positively to a known and familiar individual expressing doubt about the same data (Alexander *et al.*, 2018; Ascher, 2004; Landström *et al.*, 2015). In this report, 'the public' refers to members of the public. 'Publics' is a term which is used to refer to specific communities which coalesce around issues: for instance, in response to a particular health diagnosis or concern (Cody 2011).

People's scientific literacy—levels of knowledge and interest in technical scientific debates and information—differs over time and across subjects. People's attitudes to science and scientists (in general) may be shaped by their experiences and values, and/or by specific topics or events. Science and scientists also have a relationship with policymakers and with government, sometimes mediated by government scientists and scientific advisers. For instance, policymakers may call on scientific advisers to develop and explain policy decisions. Members of the public may then assess the trustworthiness of the scientific claims in relation to their views about policymakers, advisors, and scientists, as well as their beliefs and values.

These factors complicate the task for this report, which is to set out the key messages from leading scholarship, case studies, and investigative experiments about how and why science is considered an authoritative voice in policymaking.

Methods

An evidence synthesis

The initial phase of the project brought together existing reports, survey data, and existing published research evidence. From each of these sources, data on key factors were identified which influence trust in science-informed decision-making, including the nature of the policy problem, the nature of the evidence base, the message and messenger, and the relationship between publics, scientists, science advisors, and government.

To identify these sources, structured searches were undertaken in electronic databases, including Web of Science and Scopus. Boolean terms were used to limit results, combining text and indexed terms including ('trust', 'trustworthiness', 'confidence', 'reliance') and ('science' or 'scientific' or 'research' or 'evidence' or 'scientist'). Searching with these terms in close proximity to each other enabled the large number of results to be more focused. Relevant studies were included if papers reported: (a) empirical research data about different stakeholders' trust in science, or factors influencing trust in science, (b) literature reviews about trust in science, or (c) reports from the grey literature published by the National Academies, learned societies, or policy organisations.

Data from these sources were collated using a structured template based on the conceptual framework for the study. Based on an initial literature review and consultation with the British Academy, we consolidated the evidence on factors which influence the relationship between science, trust, and policy into four main themes:

1. **The nature of the policy problem:** Policy challenges may be complex and multifaceted, or be easily addressed through simple intervention. The number of relevant organisations and services involved in a potential solution may vary, and these solutions may be more or less highly contested, with different values and political beliefs driving debate. Public perception of the salience of policy challenges will also affect whether and how science is viewed by them as important.
2. **Nature of the evidence base:** Some policy challenges can draw on mature, stable evidence bases about which there is a high level of scientific consensus. In others, scientists have diverging opinions. Where the evidence base is more emergent or unstable, or where there is more uncertainty, scientific claims may be harder to trust. Some types of evidence (e.g. numerical) may be considered more reliable than others, but equally stories and narratives may be more influential than bare figures.
3. **Message and messenger:** How and by whom this evidence is communicated influence perceptions of the trustworthiness of claims. The format and media (e.g. blogs, scientific papers, or press releases) through which scientific claims are communicated may affect perceived legitimacy.
4. **Relationship between publics, scientists, science advisors, and government:** This complex relationship can be influenced by how scientists and government position each other and their claims within public debates, by the history and professionalisation of science advice in different policy areas, and by the politicisation of debates about policy challenges. The public is not a homogenous community; rather there are multiple 'publics' which may be brought into being in response to particular issues, experiences, or activities.

These formed our conceptual framework or organising principle for the report.

Each of these elements was considered as source documents were reviewed, and relevant information extracted from each study. Finally, these were collated, and analysed for major themes within and across each theme.

Comparative case studies

The next phase of the project was to explore how these factors play out in three different cases: Clean Air Zones, GM crops (in particular precision-breeding), and Monkeypox. To identify case studies, we consulted with the British Academy, their working group on Science, Trust and Policymaking, and with the other research team (Horvath *et al.*). We wished to select cases which would vary across the four conceptual areas described in the framework above to allow analysis of different tensions and contexts. We also wished to avoid Covid-19 as a case study due to the ongoing government inquiry. Other criteria included: a bounded scope to enable a reasonable dataset for analysis, comparability in terms of size and timeline, and addressable by methods proposed by each research team.

For each case, we developed a timeline which documented major publications (e.g. from funders, government, or major activist organisations), critical events, and media reports. To identify these, searches were undertaken on news archive sites and on the websites of identified key organisations. We also used the references of identified reports to identify further key publications. We continued until saturation was reached, that is, no further new perspective or information was identified.

We conducted semi-structured interviews to gather perspectives on the role of science, trust, and the media in determining how the policy was developed, implemented, and received by the public. We identified potential interviewees through authorship of publications, prominence in media reports, and/or long-standing activity around the case-study topic as a researcher, science communicator, policymaker, funder, or activist. Where relevant, quotes from these interviewees below are appended below.

We looked at the major discourses and opinion leaders around each case, using cutting-edge digital methods, led by the University of Sheffield. This involved identifying major scientific commentators around each case, collecting information about their social media profiles, content, and followers. We also visualised the communications networks around each case to identify key figures and discourses, looking specifically at scientific content and claims.

User testing workshops

Sense about Science convened public workshops to explore how different science visualisations landed with audiences. The materials for the workshops were co-developed with students from UCL as part of their MSc project. The aim of the workshops was to find out how participants responded to different formats and presentation styles and what were their preferences in communicating the evidence behind policies in a clear, convincing, and authoritative way.

Key findings from the experimental phase with Sense about Science:

- The consensus across the groups was that they preferred the evidence to be formatted in a standalone section or box containing all the relevant evidence separate from the policy argument or rationale to help readers quickly identify the key information they need.
- When it came to the best way to communicate evidence for policies generally, participants agreed that a combination between the separate evidence section and explanation of the relevant evidence with its benefits and limitations in the policy argument section would be the best way to communicate evidence and the rationale.
- Participants in the policy professionals workshop acknowledged the importance of discussing uncertainty and limitations in policy documents: *'Being sensible about science'* and *'We have the opportunity to take the uncertainty and argue about it. Discussing uncertainties is key.'*
- The consensus across the groups was that policy papers needed to have a definition or glossary section at the beginning to explain complex terms or topics, to avoid misunderstanding or misinterpretation. Especially when the policy is addressing a difficult issue.

- Participants liked the use of case studies as the best way to communicate evidence: *'more engaging and readable'*. They believed case studies to be more convincing than just data or figures.
- Participants thought that *'evidence should be contextualised within the real world'* to reflect people's real-world experiences, describing it as a powerful and understandable way to communicate the evidence.
- When it came to the presentation style of evidence, participants agreed that presenting evidence using more design elements such as infographics and colours was the best way to convey the evidence clearly, succinctly, and quickly. Participants liked how engaging and accessible it was over a more traditional policy paper style and a more academic paper style, especially the engaging benefit of the use of visuals in portraying the key points of the policy.
- There was a noticeable generational division between participants when discussing how to reference evidence. Younger participants preferred hyperlinks, especially for a general audience highlighting the ease of access to check the source without needing to scroll to find the reference in the footnote or bibliography at the end (which can disengage people). Older participants looked at the bibliography list to assess the credibility of the evidence. One participant (from an academic background) felt the longer the reference list, the more reassuring the argument was.
- When it came to referenced evidence, participants in the public workshop highlighted that the more recent the reference the more reassuring, relevant, and appropriate the evidence appears.
- Additionally, on referencing evidence, participants thought traditional referencing such as footnotes were not *'user-friendly',* as the onus was on the reader to find the correct evidence.

Key messages

1. Policymakers approach problems in different ways, which make it more or less likely for science and scientists to have an obvious and explicit role or voice

Policymakers—like us all—bring their own beliefs, knowledge, and history when thinking about social phenomena and problems. This applies to both politicians as elected representatives, and officials within governmental and other public sector organisations. The way that problems are framed and represented shapes who and how are considered to have a legitimate voice or expertise around a particular issue (Bacchi, 2013). By examining the narratives around problems, one can understand how political actors and coalitions seek to influence policy outcomes, legitimising particular forms of evidence, and attributing importance to certain events or pieces of evidence (K. E. Smith, 2014). When policymakers describe a problem in public, they create a framing which is based on their own beliefs, values, intended policy direction, and sources of knowledge (Hulst *et al.*, 2016; Koon *et al.*, 2016; Rein & Schon, 1991). Different political actors will also frame issues differently, as will other authority figures, such as clinicians, scientists, and media commentators. Evidence of course plays a role in this framing process (Brownson *et al.*, 2016; Stucki & Sager, 2018). It is important to recognise that the representation of any policy problem by research will always be partial and shaped by the intellectual traditions of the disciplines and the political climate—and frequently very lengthy.

With Monkeypox, for example, European scientific advisors were primarily public health clinicians and epidemiologists. They frame Monkeypox as an emerging pathogenic threat, which needs containing through collaborative action. For African clinicians, the rising incidence of Monkeypox and the huge media attention paid to it were framed as further evidence of global health inequities; the burden of disease was, as ever, much worse and much longer-standing in the global south, yet resources and anxiety about Monkeypox were concentrated on wealthier, predominantly white, communities. Once it became clear that most infections were in the population of men who have sex with men (MSM), other narratives appeared. Public health messages were described as being, or having the potential to be, stigmatising and shaming of MSM, and there was worry that the HIV legacy around stigmatisation will prevent responsible health behaviours such as seeking testing. Overall, the problem was established as one of personal choice and agency, with professional health advice offered on behalf of policymakers—so issues of trust and acceptance of scientific messaging are important to consider. Conversely, with both Genetic Modification (GM) and Clean Air Zones (CAZ), there is little potential for personal agency, as the policies remove the possibility of personal choice.

2. The way people view issues may or may not be influenced by the way policymakers frame them

Policymakers may select 'frames' consciously or otherwise to shape the public debate in a direction favourable to themselves. This is what political scientists mean by 'framing' (Rein & Schon, 1991), most usually about how politicians describe policy issues—which of course influences how civil servants may then respond. But of course, members of the public bring their own particular 'framings' to policy issues, which may or may not coincide with or be influenced by the dominant narratives favoured by policymakers, scientists, or the media. For example, CAZ is a long-standing policy initiative (in the. UK dating back at least to the early 2000s) aiming to improve air quality and address climate and carbon-reduction targets through reduction in vehicular traffic. Often, policy narratives are framed around economic benefits to local areas. However, anti-CAZ activists frame their narrative around unfair restrictions on personal liberties, and concerns about widening inequalities in health and economic outcomes.

Similarly, with GM, framings include concern about food security for a growing population, concerns about organism purity and environmental pollution, and about corporate responsibility and power. None of these framings includes a trusted professional body in the same way. Natural scientists participating in public

debate tend to frame narratives around safety of consumables, and social scientists around need for dialogue (Helliwell *et al.*, 2019).

One way of thinking about this is using the idea of technical framings and the social and ethical 'overflows' (Callon *et al.*, 2009)—that is, the issues that (some) publics see as integral to the issue but to varying degrees transgress what can be comfortably called science advice. This is what Callon describes as unexpected problems from unforeseen effects. For example, for CAZ some publics perceive the predominant debate to be about infringement on civil liberties, which links into existing resentment re Covid-19-related lockdowns. Surveys show this is relevant to a small, but distinct, minority of the population here, but there is still an issue of alienation from policy objectives and the scientific evidence used to pursue them. For Monkeypox, this 'overflow' is the stigmatisation of sexual orientation and behaviour, infringement on civil liberty (again) and a pre-existing context for distrust of the establishment, particularly related to the HIV epidemic. For Genetic Modification, the overflows might be understood in some cases to be around endemic mistrust of multi-national corporations controlling food security and consumption. These overflows can be seen as representations of the different stakeholder perspectives and value systems which operate as overlapping discourses during the lifecycle of the policy. Addressing the question of whether science helped to move the GM debates forward, one interviewee said:

> *To be brutally honest with you, I'm not entirely convinced its science that's moved it forward. I think it's apolitical and perhaps societal awareness which, ranging from say climate change through to sort of food security, and various other issues which have effectively placed it more centrally. (Activist)*

As indicated above, thinking about how the message will land with different audiences is key for effective communication. In the case of science advice, that is particularly complicated. For some groups, in some policy areas, their whole view of the role of science may be shaped by a particular event, or a particular value set which may or may not be related to the event. The public is not a homogenous community; rather there are multiple 'publics', which may be brought into being in response to particular issues, experiences, or activities (Welsh & Wynne, 2013). Different communities value evidence differently according to their background and interests (Cassidy, 2019). Evidence from America suggests that existing political beliefs affect support for science, which is less concentrated in the political right (Gauchat, 2015). Survey evidence from the UK suggests that overall trust in science has increased since the Covid-19 pandemic, but also that polarisation between trust and distrust has also increased (Radrizzani et al., 2023). People's trust in science differs according to policy topic. Polarisation about science seems limited to particular issues, rather than being generalised scepticism (Chinn & Pasek, 2021). For example, activists worked through different media to create a policy response to long Covid, creating an emergent public in response.

These issues present a challenge for science advice, in both how to navigate these tangled discussions, and in the extent to which the scientific claims can be separated out from the policy proposals. Much has been written about the politicisation of science, where scientific legitimacy is called into question where it becomes 'infected' or 'distorted' by political realities. Rather than insisting on the primacy of scientific knowledge and its neutrality, the evidence suggests that scientists should acknowledge their beliefs, values, and social responsibilities, which all act to build a sense of reliability, honesty, and public interest (Hartley *et al.*, 2017).

Although there is little discourse or expectation of publics to be trustworthy, there are discussions about competency (e.g. scientific literacy), openness (acting in good faith), and responsibility (e.g. acting in the common good). This could be taken to mean a public ability to absorb and critically reflect on scientific claims made in relation to policy directives. There are likely different expectations in the political community about the likelihood that the public will be open and honest about their own actions and motivations, which in turn affects policymakers' preferences for different types of policy instrument.

3. Use of science by itself does not make policy more trusted

Although becoming rarer, there is a long-held belief amongst some scientists that the main issues between science and society (including policymakers) is one of a lack of knowledge and understanding—often termed the 'deficit' model (Gregory & Lock, 2008). Many initiatives are designed with the basic assumption that the more evidence which is delivered to policy, the more will be used and the better policy will become (Boaz *et al.*, 2019). This 'knowledge deficit' model governs many knowledge exchange initiatives, but is not an accurate representation of evidence use in policy contexts (Oliver *et al.*, 2022)). The basic argument can be summarised as a series of flawed assumptions.

A. More use of science will improve policymaking.

Few would argue with the premise that, in general, a more informed political community and a more nuanced public debate which is enriched by knowledge of all kinds would be an unequivocal good. This is not the same as arguing that there is an obvious and uncontroversial policy implication for every research study, basic or applied. Yet many scientists do hold this or similar views (Cairney & Oliver, 2018). Empirical studies of evidence use suggest a rather more nuanced relationship which does not follow this 'linear' pathway (Best & Holmes, 2010). Instead, there is a growing recognition that relational work is required for knowledge to travel, and that the wider context or system, meaning organisations and individuals within this context, all contribute towards evidence use (Hopkins *et al.*, 2021). This suggests that, rather than evidence providing off-the-peg policy solutions, where the policy implementation is part of the research life-cycle, in fact evidence production and use are part of the policy cycle, which includes many other factors, influences, and indeed sources of knowledge (Cairney, 2016b).

Evidence does not generally inform policy in the linear, instrumental, way described above, where it 'helps' policymakers choose between simple options. Policymaking is a complex affair, and evidence—which rarely speaks with a single voice—is one influence amongst many (Cairney, 2016a). One major factor is the culture and history of evidence use within policy domains. Some government departments, and consequently their policy portfolios, tend to explicitly frame problems in terms of knowledge gaps and evidentiary inputs. Some policy areas have trusted professionals, experts, or institutions with a mandate to shape decision-making (such as medical professionals or economist advisers), either through production of evidence or through participation in decision-making processes (Laumann & Knoke, 1987). In other areas, a broader range of stakeholders, including the private sector and think tanks, are perceived to be credible sources of evidence. The number of relevant organisations and services involved in a potential solution may vary, and these solutions may be more or less highly contested, with different values and political beliefs driving debate. As an example, one interviewee described how—for them—the whole debate around GM was an ethical issue:

> *I always I started off with a really strong - I would say moral, actually, principled objection to this patenting. I think that—so that's where to me, there's a really straight line. It's just not right to hold a patent on genetic material that just really crosses an ethical line. (Scientist)*

This illustrates that for this interviewee, corporations were not a legitimate participant in debate and their inclusion would challenge their deeply-held beliefs and values.

B. People don't use evidence because they don't understand it.

There is a widely held conviction amongst scientists that publics (and indeed policymakers) cannot understand uncertainties and believe stronger statements are more trustworthy (McBeth *et al.*, 2016). Mistrust in science, or scepticism, is often conceptualised by the scientific community as being due to poor scientific literacy or 'rejection' of science (Chinn & Pasek, 2021). As one interviewee put it:

> *The more you tell them about the science, that more sceptical they became. So it wasn't that there was any deficiency of knowledge, but people were suspicious of the motives of why people were talking to them. The great majority of the public just want good cheap food, they don't want to be told about where it comes from. They linking of science to food is not something that appeals to them. (IDBST001, scientist)*

Although this quote provides a far from comprehensive summary of public attitudes to evidence, it does demonstrate an increasing awareness that scientific evidence is not a magic bullet to cure public distrust. To summarise, decision-makers and members of the public are not prevented from engaging with science by a difficulty in comprehending it.

C. People will use evidence where they can see direct relevance to themselves.

In the literature about evidence use, this is often described as 'cherry-picking' or 'tactical' use of evidence, to defend pre-existing political or ideological positions. It might more usefully be thought of as an inherent aspect of how humans filter the information thrown at them by the world, by which what appears more relevant and useful automatically becomes more salient and present. One interviewee explained that people would be more positive about science where they could see direct relevance or a benefit to their own lives:

> *[where the public perceived] you're using GM for a biomedical purpose, and that's been a long-standing difference where people's attitudes to GM and gene editing, if it gives them a direct benefit or particularly if they're ill, then then that's fine. (Scientist)*

The science communication experts we interviewed held a different view: that often people were not looking for instruction. Describing their approach on social media, one interviewee said:

> *I would say, with positive rather than negative or scary emotions throughout the content; educational light rather than serious, most of the time; non-confrontational. … I mean, people are on social media usually not to become educated, they they're usually to be entertained. So you're forced to try to hold interest as much as you can throughout content. (Social media user)*

D. Lack of understanding or interest can be overcome by improved communication techniques.

This assumption holds that scientific impact can be increased through making stronger, more persuasive, claims and/or transmitting more information (Kaufman *et al.*, 2022). Science communication literature often characterises effective communication as that which is persuasive, or instrumentally informs a change (Crowley *et al.*, 2018; La Bella *et al.*, 2021). Again, this relies on the debunked 'knowledge deficit' model, which implicitly assumes that scientists have answers to societal problems, which merely require wider dissemination. Part of the confusion here arises in the conflation of communication of scientific information (including uncertainty about conclusions) and communication about potential implications, such as policy proposals. Similarly, the way in which scientific claims are communicated and the degree to which they are strengthened to be persuasive may limit the honesty of these claims.

Our data suggest that statistical uncertainty did not, in itself, influence how people responded to scientific evidence. One interviewee suggested that messages which were too 'polished' could put people off:

> *I don't think this is intentional, but it is a side benefit of doing it on your phone. You don't want your content to seem over polished. I think one of the main benefits of individual people like me. In contrast with like big health organisations making content about educational issues is their content is way too polished. You like feels like TV content, or like the commercial or something. It doesn't feel like it's authentically coming from someone sitting in their living room or their office like recording a video. (Social media user)*

Overall, our data suggest that members of the public are willing and able to engage with scientific content provided that it is presented in a way which invites engagement:

> *That's the one thing the scientists have in the, you know, in their arsenal that that the campaign has done and the people who are ideological campaigners are spinning umm spinning the truth—cherry picking evidence. Sometimes just lying ….*

> *But most people want to hear the truth. And when scientists can explain it calmly, intelligently, without dumbing it down, but having to simplify it for a general audience, but without being patronising then. Then, then that goes a long way in the long game, and so I don't see these as kind of media training skills. (Social media user)*

On the other hand, campaigners and advocates can feel at a disadvantage, due to the social status accorded to scientists:

> *There is very much a narrative that pits campaigners against scientists. It's something that we will quite often try and resist. So I'm asked to do debates and TV and radio and stuff going head-to-head with scientists, and I do do them, but I'm very careful about them …. because I don't think it's terribly helpful because there is an elevated status given to the scientists, particularly if the interviewer or the chair or whatever doesn't understand any of the science. … I can point out all the ways that the scientist is wrong, but no one else will understand. And they've got the title and I haven't. (Activist)*

One can see here the need for all participants in public debate, scientists, media, and other representatives, to be aware of the wider dynamics, and to work together to find a respectful discourse which addresses concerns and values different contributions.

E. 'Improved' means 'with less uncertainty' and 'with more consensus'.

Many scientists are concerned with the communication of risk and uncertainty, arguing that there is a tension between 'revealing' uncertainty, and the clarity required for unambiguous advice (see, e.g., Folker & Sandøe, 2008). Recent research suggest that on the contrary, communication of uncertainty does not affect people's trust in scientific claims (van der Bles *et al.*, 2020). Format and media (e.g. scientific papers versus blogs) may influence perceived legitimacy, but communication of uncertainty only affected perceived trust in scientific statements where it was portrayed as linking to a disagreement or lack of consensus in science (Gustafson & Rice, 2020). In practice, this means public trust in science is likely to be affected where scientific conflicts or lack of consensus are actively performed, but is otherwise unaffected by concerns around methodological quality, results, quantity, or type of evidence (Aitken *et al.*, 2016).

The idea that scientists should preferentially be allowed access to 'uncertainty' is deeply elitist and strikes at the principles of honesty and responsibility required for trustworthiness. More recent analyses suggest that greater transparency should be a goal for all, but that it may still be ethical to use scientific evidence to persuade 'rather than enable them to make an informed choice' (Oxman *et al.*, 2022). In this paradigm, government or other scientific communicators may act on a continuum between informing to coercion; and where they choose to land should be decided on a case-by-case basis. For advocates of this approach, transparency becomes the explanation of what happens between the data and the policymaking, rather than how the data were produced or what they mean in scientific terms and the uncertainty around them.

Scientists often focus on the need for consensus as being inherently more persuasive to the public, and more authoritative in policy spaces (Pearce *et al.*, 2015). The assumption is that, as people are exposed to scientific conflict, they place less weight on scientific claims, which reduces support for public action (Cook & Pearce 2019). Consensus messaging is said to increase support on scientific claims for those who already have positive attitudes to science (Chinn & Lane, 2018), although from non-trusted sources (such as industry scientists) it has a negative effect on public trust (Suldovsky & Akin, 2023). Indeed, there is some evidence that policymakers benefit from being exposed to points of disagreement (Stirling, 2010), and are responsible for charting a course between conflicting opinions and interests as part of their professional practice (Cairney, 2016b). For this to work well, scientists involved in delivering advice to policymakers, such as science advisors, would need to act with integrity and moral rectitude; not, for instance, undermining messages to score political points (personal communication from British Academy Roundtable on Trust). One could argue that

this applies to all publicly funded researchers, particularly those who share their research and possibly implications on media. As one of our interviewees put it,

> *Scientists have to be much more careful about thinking about the audience before you say anything at all. (Scientist)*

This was echoed by another participant who described a 'science v the world' schism:

> *So I remember finding the public turned the debate just quite alien in the early days of GM. Didn't engage with it at all because and I guess I was at that point probably still instinctively backing the scientists, you know…And I've had many, many experiences of people who regard themselves as scientists who know nothing at all about genetics. So, you know, physicists or geologists or anything, but somebody who regards himself as a science scientist, giving me a great deal of their opinion on why I'm wrong…There is a sort of sort of science versus the world kind of thing. (Activist)*

Here, one can see a connection back to consensus, and the credibility of individual scientists—presumably feeling under attack—and thus overstating their confidence in a scientific claim. Although ostensibly about accuracy of scientific information, this interviewee is describing the ways in which scientists too feel part of a community, with the in-group pressure to defend each other against attack, and a strong sense of identity. These values and beliefs need to be interrogated and reflected on, for science communication to truly improve.

F. Trust can be built through improved communication techniques.

Many scientists believe that communicating more, and more effectively will increase trust in scientific claims or policies which draw on these claims. This 'folk theory' of public understanding of science is based on flawed assumptions, often made by scientists and policymakers, which indicate a low opinion in the trustworthiness of the public (in terms of their capabilities, interest in the common good, and in good-faith engagement with policy debates) (Landström *et al.*, 2015). Partly, this is because there is a growing problem of misinformation: that is, either dissemination of inaccurate information, or use of scientific data to support (often extreme) political positions. While to some extent all science communication is likely to support certain political positions, there is s difference between expression of values and the use of skilled communicators deploying their skills in ways which create false narratives seeking to polarise people:

> *People assumed Covid was broadly a threat to, you know, everybody in the world, and people came away from Monkeypox, assuming, oh, it's only a threat to men who have sex with men, or or something which was obviously not correct. But I think that … I seem to recall there were misguided tweets and new news headlines and tweets from members of the US government who framed Monkeypox as only for men who have sex with men. And then they were talking about how there were cases of Monkeypox in children, and therefore it implied sexual abuse of those children.*
>
> *Of course, framing it in that way is exactly how you get your tweets and your videos to get as much reach as possible, which is in your benefit. If you want the spotlight to be on you. …That wasn't a common interpretation. But I do recall that were at least a few Congress people in the US who were driving those sorts of narrative to support their overall view of 'I don't support the rights of LGBT populations', or or 'they're grooming children', or this narrative they had already been building. They sort of slotted Monkeypox into that. (Social media user)*

A different approach to science communication focuses on the building of (mutual) understanding, such as by using metaphors to improve accessibility of knowledge (Kendall-Taylor & Stanley, 2018), or through dialogic approaches. This concurs with literature on conflict resolution, which emphasises the need to build trust via dialogue, willingness to share power. This literature recognises that seeking to increase trust by, for example, being more persuasive and forceful in scientific messaging can damage perceived trustworthiness, by, for example, compromising the perceived honesty or reliability of the messenger. The communication of the evidence base is key to establishing trustworthiness. This approach recognises that communication is as much

about listening and learning as it is about broadcasting (which is often the focus of traditional science communication methods):

> *We must do it through the questions: listen first and say, well, what do you like or dislike about certain food products. And I think that finding the same kind of thing that that there's a group who are always enthusiastic about science and like to, you know, know about astronomy. And then there's the ones who say, well, don't tell me because I, you know, I don't believe a word you say. And I never will …*
>
> *You got to listen first and then you can sort of answer specific questions. If you if you do anything else you lose people completely, terrorise them into saying that you're somehow changing DNA and you've already said DNA is so important and now you're saying doesn't matter if you change it and so there's all sorts of angles on that. (Scientific adviser)*

Questioning was also raised by another interviewee who explained that this approach was a leveller between people with different views, levels of experience, and knowledge:

> *I'm not a math person and because I was that person and felt that the way that things were explained to me or the way things were taught, or the way the news, for instance represents science, was so misleading and confusing. And again, alienating. I yes, wanted to do it for myself. So I think it's very difficult as scientists and as researchers and academics go further along in their journey, that gets harder and harder to refer back to the time when you didn't know what you know about your subject.*
>
> *And so it's always really valuable thing for me to ask myself for any experts that I'm interviewing. Tell it like you were telling it to your 12 year old self or you know your mother, who is not. If they're not a science expert, so always coming back to the understanding of what do people not know, what misunderstandings do people have? What questions do people have and how can we speak to those first so that we have an in with that audience? (Science communicator)*

As this quote and the next illustrate, the key point is that scientists need to recognise that, although other audiences don't have the same level of expertise, that should not and need not be a barrier to open and effective communication. Remembering that we are human first, scientist second remains important for effective communication:

> *I see a lot of new science communicators or science communicators who have been in academia for a really long time, really trying to say, like, at the beginning of their videos, I'm a PhD in blah, blah, blah, blah, blah. Therefore, the rest of what I'm saying you should listen to, that's not going to work for the people who we really need to be talking to. So instead of leading with credentials, I try to and (this sounds so silly, and it's unfortunately all sort of social interaction), but basically just be as friendly and open and layman as possible, as the person explaining it, so I'm not presenting myself as me up here unilaterally transmitting information down to you. 'It's me down here, Hey I'm confused by this, This is what I've found out. What other questions do you have?' (Science communicator)*

For this science communicator, the starting point was admitting their own ignorance about the topic and explaining their curiosity about it, and how they found out more. This will not be the case for all science communicators or advisers who are often starting from a position of more knowledge than their audience. However, the approach can be adapted, explaining interest, curiosity, and importance, before moving to technical detail. The importance of honest, authentic communication was raised by interviewees, particularly around being a key factor in how people decide to trust scientific claims:

> ***Interviewee**: I think that authenticity is a huge part of what drives people to accept opinions from basically random people online like me, where they might not trust someone like the US CDC [Centre for Disease Control], or the FDA [Food and Drugs Agency] or something.*
>
> ***Interviewer**: So it's too professional?*
>
> ***Interviewee**: Yeah, man, there's a big risk of being too professional having your video be too clean. Feel too scripted. people can tell within a fraction of a second. If it's not basically someone being authentic recording into their phone.*

> ***Interviewer****: Why do you think that puts people off? Why do you think that personal touch matters?*
>
> ***Interviewee****: I think probably most people when they think of a big organisation like the FDA or the CDC. Or the NHS. … They probably don't immediately put … a face to whatever recommendation they're reading. It probably comes as like this anonymous government organisation that's telling them to do something. And so I think building a personal relationship with people—not even just in educational videos, but also in like joke videos or dance videos or something where you really build up that rapport over time makes them more likely to trust whatever educational information you end up giving to them. Probably the best example of this actually is one time after a live stream that I was doing. This is back in when Covid vaccines were first coming out and so obviously the entire livestream was talking about the Covid vaccines. But at the end of it I said, like I've got to go. My wife's about to get home from work. I've got to make her dinner, or something like. 30 min later, or something. I got a DM. From someone who's like, I didn't believe anything you were saying and I wasn't going to get Covid vaccines until you said you had to go because you had to make your wife dinner. And like, I realised that you're a real person.*
>
> *But basically, it didn't matter how many research studies I cited, or like. What evidence I was showing on the screen. What they wanted to know was, Oh, he's a regular person, and he's being genuine, and what he's saying here. (Science communicator)*

Thus, it is not the engagement per se which generates trust, nor the strength of the communication, nor consistency of message or the clarity of the scientific evidence. The power of the consensus statement comes from the process—explicitly the (early?) inclusion of different viewpoints and how these different stakeholders become accustomed and tied to a particular document and hence part of a policy process. This can be seen in practice where arguments that explicitly use scientific evidence in the pursuit of political aims are likely to be more powerful than more careful consensus statements emerging from official scientific advice. The point about timeliness was also raised by one of our interviewees:

> *Often what happens is: There's a row in the media and no one sees it as their responsibility because you know any individual scientist could say well. 'This isn't about me or my work'. Press offices, or often institutional well, they're always institutional apart from us, and they would say, well, this isn't about my institution, so that we don't need to get involved. Some people are very risk averse and they just think, well, I'm going to keep my powder dry on this one and not get involved. … We shouldn't fan the flames because all that means is 'I'm too scared to get involved. … Let's hope it all goes away and stay quiet.' And in the meantime, the story is on fire, and you're not doing anything to help it. And last thing to say, I think on that is this message that every threat is an opportunity. So when people don't want to get involved at the scariest time, but the scariest time in a story is exactly when everyone should get involved. Because that is when the public are interested. That's when journalists are interested. That's when you've got their attention. (Scientific adviser)*

In practice, then, improved communication techniques means being able to discuss risks and benefits, respond in a timely fashion, being brave enough to face potential pushback and other negative consequences to get involved in debates, and to commit to the long game:

> *You sometimes see when you look at these things over and over, the long term is that in the beginning you have people kind of pitch together in opposition and we got that a lot with GM crops because journalists. Simply it was too much for them to believe that the scientists had the whole story on their own. And that's OK, because science isn't always the whole story. (Scientist)*

4. Trustworthy institutions, people, and processes are those seen to be competent, honest, and responsible

Trust between government and its citizens is an essential component of effective policymaking. (Chataway *et al.*, 2020). People will support and follow individuals and institutions they trust; in turn, trustworthy people act in the public interest. These can be thought of as two ideal types: (a) 'push', by persuading people to have more trust in science, government, or other public institutions, often through optimising 'messaging', or (b) 'pull', by increasing the trustworthiness of those institutions themselves.

Attempts to increase trust make unreliable assumptions about how people's beliefs shape their attitudes and behaviours. For example, scientists and journalists often assume that more information will assuage doubts

and fears, leading to acceptance of their recommendations. The Gateway Belief Model formalises this assumption into a theory which claims that more effective messaging of scientific claims leads to changes in public attitudes about science (van der Linden, 2021). If this were true, misinformation could be easily dealt with by simply 'drowning out' incorrect claims with more accurate information (Jacobsen, 2019). This model, and these assumptions in general, are based on the idea that 'filling' the information deficit is the main barrier to action for most people. It is a rather traditional view of science, which is now regarded as at best an over-simplification (Grant, 2023; McNeil, 2013; Miller, 2001). Even the largest scale studies do not provide good empirical evidence that these approaches build trust effectively outside of short-term experimental conditions (van der Linden *et al.*, 2019). People's attitudes are shaped by their experiences and beliefs, and scientific knowledge gaps and claims are often so context-specific that they do not shape overarching beliefs. Scientists can also have a very narrow, detail-heavy focus which can prevent people from engaging people's imagination more broadly.

Attempting to influence the trust people feel directly is not an effective approach. Moreover, even where trust is reliably measured in experimental settings, it appears to be a highly contingent and transient relational property; as though 'trust has to be earned every time you walk through the door' (Denner *et al.*, 2019, p.10). Building perceived trustworthiness is a more promising approach. Evidence of reliability, competence, and honesty offers an impression of trustworthiness (O'Neill, 2018). A further domain of 'responsibility', which we interpret as caring, fairness, and benevolence adds a moral dimension to capture the relationship between public institutions and those they serve (Chataway *et al.*, 2020).

People are more likely to trust those who they believe will act in their interests, or in the interests of the common good—or more accurately serving the publics' interests. However, this itself emphasises that one cannot expect unanimous public trust in science on any issue.

People find institutions less trustworthy where these ideals has been violated—although one-off events may be forgiven against a background of consistent trustworthiness (Slovic, 1993). People's perceptions about performance against these ideals will vary over time, by topic, and by group (for example, some groups may perceive unfair treatment as discriminatory or offensive, leading to a perception of procedural injustice). Building trust, therefore, does not mean trying to convince the public to change their minds, but rather acting to improve performance across each of these components which will build trustworthiness. These efforts may be rewarded by an increase in the trust people feel towards these institutions.

Overall, trust in scientists and in experts in the UK—as abstract categories—is relatively high, although the evidence is not high quality (Dommett & Pearce, 2019; B. K. Smith & Jensen, 2016). Trust in government scientists is slightly lower, with survey data during the Covid-19 pandemic showing 55% compared with 60% saying they find scientists who advise government trustworthy (Skinner *et al.*, 2020). This may be because of perceived partiality or conflicts of interest, or—more probably—because this concrete category calls to mind specific individuals who are then not assessed as ideals but as familiar faces.

This abstract level of trust does not necessarily read over into specific issues, where publics may legitimately question the positioning and interests of any given expert. There is some limited experimental evidence to support this (Stafford, 2016). For example, where issues have more immediate personal salience (such as a health care matter, or about a deeply held belief) scientific claims may be more likely to be scrutinised. Scientists of course have their own beliefs and value systems which direct their work. A good example is from the debates around Genetic Modification where the scientific discourse focuses on the safety of crops; yet civic groups were also concerned about corporate power and vested interests, biodiversity, regulation of emerging technologies, and food security (amongst other issues) (Helliwell *et al.*, 2019). Where there is such a mismatch in terms of framing, generalised 'trust' will not carry over into a blind acceptance of scientific claims. Rather, the public can parse individual and corporate benefits, and assess risks and benefits in multiple ways:

> *The key was that the motive for involvement [in the policy debate about GM] was driven by self-interest. Science is competitive by nature and these scientists could not distinguish between private and public good. The fact that the food industry is ruled by big private corporations (e.g. Monsanto) makes the public question what's in it for me. In this debate some scientists became mouthpieces for these big organisations. (Scientist)*

There is some evidence that trust in science in general is higher in the higher socio-economic groups, although the difference is small in absolute terms (Skinner *et al.*, 2020). Similar small effects can be seen when analysing by ethnicity, gender, and class. It does seem to be true that wealthier classes, who are often better educated, have higher trust in institutions (Kennedy, 2020; Steedman *et al.*, 2020). On some issues, such as Genetic Modification and Climate Change, there is evidence of a positive correlation between education level and scepticism, although this is highly contested in the literature (Hornsey *et al.*, 2021; Kahan *et al.*, 2012; Taylor-Gooby, 2006). There is also a relationship with engagement in politics. However, this is not due to improved knowledge or scientific skills, but rather connected with group identities and values, such as personal autonomy and belief in collective action.

The honesty and transparency of science could be narrowly conceived of as being about data transparency and open science (Nosek, 2017). But of course, there is more to science than just methods and publication. What of claims made by individual scientists? Much has been written about what makes experts authoritative: for example, professional or personal credibility (Cash *et al.*, 2003b), or legitimacy through training, context, and skills (Grundmann, 2017). As Grundman argues, expertise is largely a relational property which is determined by audience; one could say expertise is in the eye of the beholder. In practice, this means that there are no fixed qualifications which determine expert competence beyond question. The trustworthiness of experts is called into question by conflicts of interest, funding through vested interests (Friedman, 2002; McCambridge *et al.*, 2014), and straying beyond the limits of one's expertise (ALLEA, 2018). However, once someone is trusted, these external signifiers cease to hold much importance:

> ***Interviewee**: I know very few people actually go look at that source to see if what I'm saying matches up to that source. I've seen it misused by others. Putting a source on the screen, putting the screenshot of a paper, misrepresenting what that paper said, and convincing hundreds of thousands or millions of people that what they're saying is true because they've got a source on the screen. … Anyway, it feels more like a tool to convince people that what I'm saying is true without any due diligence.*
>
> ***Interviewer**: So I mean, if you do, if you what? What steps do you take to try and give that legitimacy without sort of kite marking it with a, you know, 'science stamp'?*
>
> ***Interviewee**: Yeah, I mean, that's what I do. I just do the science step. And interestingly, for a while, people used to ask me about my credentials, like, where did you do your training, or what do you know about this topic, or whatever? As my account got larger, people totally stopped asking that question, I got hundreds of thousands or verified. It was like there was the social proof of oh, you must be legitimate. He knows what he's talking about. He's got a million followers, and he's verified. Now people don't ask me ever where I did my PhD. (Science communicator).*

Clearly, the credibility and authoritativeness of experts is not just about competence and honesty. Evidence suggests local champions and opinion leaders, who are familiar sources of information often operate successful as trusted communicators (Baycheva-Merger, 2019). A past history of communication and trust is an important factor in increasing levels of trust, particularly face-to-face and regular interactions; and particularly important is the sense that communicators have shared interests with the audience. Put another way, alienation and a sense that scientists or science communicators do not have the audience's interests in mind lead to mistrust (Stafford, 2016), all of which enable the honesty of scientists to be called into question; and, indeed, the extent to which scientists are addressing questions of importance to other stakeholders—including the public.

This can be seen in the social media analysis of the Monkeypox case, where key influencers acted as disseminators of knowledge. Both the key candidates identified claimed some scientific or medical qualification, but only one (and the more successful judging by online interaction) did so from within a usual

practice of sharing daily insights and experiences on the social media platform. Seen as an equal and a peer made this person perhaps particularly acceptable to those seeking information on a new medical phenomenon. However, this does not mean that the official public health bodies should seek to behave in the same way. Rather, scientists need to recognise and respond to their public responsibilities through reflection and debate. As one interviewee put it:

> *Scientists are trusted by the public, but we need to understand trust and unpack it. Scientists never asked the question—am I trusted by society? (Scientist)*

Science is largely self-policing via peer review, and so the processes and evidence needed to assess science are largely produced by and for scientists themselves. For example, scientists point to rigorous application of appropriate methods, transparency, and reporting around research data, and use of particular research methods (Guttinger & Love, 2019), possibly deriving from particular scientific processes (e.g. economic, or quantitative, or experimental), although in fact this assumption is not supported by the empirical evidence. One might expect expert advice to reflect contemporary understanding of a problem, which would be constantly evolving, requiring updating regularly (Herman & Raybould, 2014). External regulation too, in the form of Research Assessment Exercises, attempt to provide a quality assurance to the practice and outputs of science (ALLEA 2018). However, all these processes focus on the production of knowledge, rather than its appropriateness, or whether it is fit for purpose. Indeed, there is some evidence that scientists are not good judges of what is considered 'good' evidence—with self-proclaimed experts, being rather more biased than those with objectively assessed domain-specific expertise) (Liu, 2013).

5. Instead of placing the responsibility on publics to become more trusting, science and policy systems should seek to become more trustworthy

There is no silver bullet solution which will enable governments and science to be perceived as wholly trustworthy by all people. However, more can be done to bolster perception of (and actual) performance against the ideals of competence, honesty, and responsibility. We should remember that these are necessary but not sufficient conditions to engender trust, and publics will respond differently to them. In essence, this is not about transmitting more evidence or trying to convince people to trust and be more compliant with policy, but rather thinking about how to make systems trustworthy (Aitken *et al.*, 2016).

The temptation for scientists and governments who wish to be more trusted is to follow a set of rules which the above findings imply, to become more trusted. These include explaining the background to decisions, creating a personal connection, and engaging with people's concerns and experiences. However, ***the primary finding of this report is that, although similar factors seem to correlate with trust, these factors cannot be retroactively applied to science or policy to generate trust.*** Merely tailoring messages to appear that they do engage with people's concerns, or seeking to use local opinion leaders to champion science messages, would not be effective. The trappings of trust do not lead people to have trust. Rather, the ***attributes of trustworthiness are earned through going through processes which in themselves render all actors more trustworthy***. Merely engaging with people to *make them trust* undermines the very process by which trust is in reality engendered; the process of honest, authentic, co-learning (Wynne, 2006).

As Gregory and Lock put it:

> *'the exercise of dialogue was intended to build and reconstruct social relations, rather than to generate social-scientific data (Wynne 1991). Social relations are of lasting value to the parties concerned in the dialogue, building greater trust or facilitating mutual respect; data are exported and are of value to non-participants. Thus, participants are exploited, and engagement can be experienced as a form of information management: as Beder noted, the event becomes a public relations exercise (Beder 1999).' (Gregory & Lock, 2008, p.1261)*

This appears to operate at many different levels. By engaging authentically and honestly with each others' concerns, all participants learn and are more persuadable. By explaining the pros and cons to policy decisions, and the evidence and gaps which were part of those decisions, policymakers render themselves more understandable and more trustworthy. Thus, there are obvious steps which all can take to support more trust in public institutions, in science, and in policy.

Conclusions

The classic assumption is that use of science in policymaking will increase trustworthiness of government in ways operating across all domains because science is apolitical and will 'improve' policy by providing solutions to the many challenges faced by policymakers. However, we know that this linear, apolitical vision is not reflective of reality, although it does, as mentioned earlier, inform many knowledge exchange initiatives. Science and science advice can still support the trustworthiness of policymaking and of government by providing a clear and transparent rationale for decisions, making policy more reliable, transparent, and accountable. Yet, as we have seen, this complex relationship is influenced by how scientists, science advisors, policymakers, and government (amongst others) position each other and their claims within public debates, by the history and professionalisation of science advice in different policy areas, and by the politicisation of debates about policy challenges.

One of the tasks of the formal science advisors is to bring in evidence from outside their own disciplines, and to assess and communicate consensus across those domains (Collins & Evans, 2002). In terms of science advice, delivering advice in line with the scientific consensus would engender more trust in the audience (Gundersen & Holst, 2022). Generating consensus is an essentially untraceable process, which is largely dictated by group dynamics. Opening up the consensus process through, for example, direct voting, or by dialogic methods, is one way to generate more trust in the process. There is a difference between generating consensus, communicating consensus, and using consensus as part of persuasive message. Generating consensus—in an ideal world—is about working out what can be said with confidence from the evidence available, and not necessarily about resolving difference or conflict. There is a difference between working out what can be clearly said about the evidence and asserting consensus to make a political point.

The example of the IPCC (Intergovernmental Panel on Climate Change) is instructive here. The process of reaching scientific consensus reached is less the achievement of objective truth than the layering of multiple compromises (De Pryck, 2021). While this has led to various criticisms of their final assessments being too conservative or too alarmist, the political power of the consensus comes from the process itself, drawing together multiple lines of evidence in a relatively open, peer-reviewed process (this has opened up over the years) (Hulme, 2022) The challenge for scientific advice is to try to establish a consensus process that is publicly legible, but within time periods that are usually far more constrained than that faced by the IPCC. For some issues, one could imagine an IPCC-type process (Pearce *et al.*, 2018)—clearly more challenging (but not impossible)—in an emergency situation such as Monkeypox.

Although trust in science is high, and trust between researchers and policymakers seems to increase uptake of evidence, this does not automatically translate into trust in science-informed policy, particularly where the translation of the science is not seen as competent, open, or responsible. Where policymakers foreground scientific claims as authoritative, some publics may perceive scientific involvement as more legitimate, but transparency in science advisory systems and relationships influences perceived trustworthiness. Rather than a silver bullet solution to bolster policies where needed, or a neutral and objective form of expertise, evidence could perhaps more usefully regarded as a political asset (Baycheva-Merger, 2019), which can be deployed carefully in the service of trustworthiness.

Trustworthy governments are seen to be competent, honest, and fair. This gives them legitimacy to act. Perhaps this is particularly the case in liberal democracies such as the UK, where governments tend not to use executive power to limit personal freedoms—where governments rely on public compliance with policies rather than on enforcement. Even when legal measures were deployed by the UK government during the Covid-19 pandemic, they served primarily to clarify expectations and solidify existing social norms (Chataway *et al.*, 2020; Jackson, 2020). In general, in the UK, trust in government is relatively low (ONS, 2022) with

perceived violations of all competency, honesty, and fairness damaging public perception of trustworthiness (Fancourt *et al.*, 2020).

False alarms are more tolerated than missed chances, because this is attributed to a responsible, benevolent motivation—a feeling that the government 'has our interests at heart' (Chataway *et al.*, 2020). On the other hand, patterns of behaviour are more important than one-off events (Slovic, 1993), so cultural norms and long-term narratives shape perceived trustworthiness significantly. Visibly and demonstrably acting in the public interest, with processes leading to equitable and respectful treatment ('procedural justice' (Herrington & Roberts, 2013; Nagin & Telep, 2017)) can increase the perception that government wishes to be transparent and accountable. Trust is built through fair participation in dialogue, which helps to resolve conflicts in the policy arena (T. Young *et al.*, 2018).

A trustworthy government might enable open data (although there is public ambivalence about this (Souza *et al.*, 2022). It might promote greater transparency in science advisory processes with an emphasis on fairness in process, including selection of experts and consensus making (Elliott, 2022). It would certainly draw on a broad range of perspective and evidence types, and ideally ensure consistent messaging and behaviour from leaders and advisers. Where policymakers foreground scientific claims as authoritative, some publics may perceive scientific involvement as more legitimate.

Trustworthy science advisors represent evidence and its limitations accurately, without deliberately withholding information and taking likely social impact of advice into account (Gundersen & Holst, 2022). They must also be able to judge when scientific information is 'good' enough to be communicated. This is a value judgement and one which speaks to competency as well as moral rectitude and humility (Douglas, 2000). Engagement between scientists and government does not always demonstrate good-faith assumptions. It is not uncommon to find the assumption amongst scientists that they will be used as scapegoats or shields to legitimise existing policies. Transparency in science advisory systems and relationships influences perceived trustworthiness. Trust between researchers and policymakers seems to increase uptake of evidence (Oliver *et al.*, 2014), although studies from classic science communication have found that people will ignore information which directly contradicts their beliefs (Jacobsen, 2019). Trust in science does not automatically translate into trust in science-informed policy, particularly where the translation of the science is not seen as competent, open, or responsible.

Trustworthy research institutions and researchers provide support for researchers to become better public servants and consider their public responsibilities. They promote and support greater engagement and discussion at all stages of evidence production and use—ideally, through effective, evidence-based, ways to promote engagement between academia and government. Scientists, like policymakers, have beliefs about what constitutes a public good; both politics and science are shaped by values and goals. Being open and honest about how these have shaped science and its interpretation may help build trust amongst the public. Universities need to find ways to help scientists recognise and be honest about their values, and to navigate the risks and consequences of doing so (Douglas, 2009).

Trustworthy media would be seen to be equally invested in public interest stories which had implications across the political spectrum, and not be swayed by pre-existing partisan values. Biased reporting and misinformation can only be partially addressed through debunking and fact-checking, which may be better addressed through higher scientific literacy and attention to psychographic and cultural factors (Chataway *et al.*, 2020). Trust in media and journalists generally is low in the UK, and possibly worsening with questions around politicisation of the BBC, ownership and regulation of social media sites, and perceived low benevolence of newspaper magnates towards the UK population at large.

For all interested in **promoting better use of evidence in decision-making**, we need to promote good-faith interactions between publics, government, and scientists. We need to investigate the use of sustained and meaningful deliberation, which is clearly more challenging at national than local levels, and there is limited

evidence about how to do this well (Wilson *et al.*, 2020). Active, good-faith engagement with stakeholders seeks to build shared understanding, rather than transmission of knowledge (Chambers, 2017)—and this may offer a way to build trust. This will involve negotiating conflict between stakeholder groups (J. C. Young *et al.*, 2016). Such trust-building requires effort and resources, opportunities for appropriate dialogue between stakeholders, and a willingness to share power in terms of knowledge and policy implementation. This type of sustained interaction goes beyond mandated consultation, which is often focused more on public framings of problems, than on conflicts between them (Boyd & Lorefice, 2018).

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