Note to the Reader

The essays assembled here grew out of a joint research project of the three authors, "Scientific Experts and the Pressures of Pandemic Policy Advice", which was funded by the Volkswagen Foundation between 2020 and 2022, under the auspices of its special funding programme "Corona Crisis and Beyond: Perspectives for Science, Scholarship and Society". While the first two essays, by Stephen John and Axel Gelfert, deal explicitly with the Covid-19 pandemic and its implications for the interrelationship between science and society, the final essay, by Mathias Frisch, widens the perspective by taking into view the looming climate crisis and our collective failure to represent its scale. Taken together, the three essays aim to cast a spotlight on how scientists and science communicators should engage the public in times of crisis and under conditions of pervasive uncertainty.

Certainty and the Limits of Science

Stephen John

In reflecting on his role as Chief Scientific Advisor to the British government during the Covid-19 pandemic, Patrick Vallance worried that

> many people think science is about the facts you get out the other end... [but] we're always challenging those facts, and we're trying to look and things change, and that uncertainty is part of the progress of science (quoted in Dimsdale 2021).

Vallance thought that combatting a false everyday philosophy of science was important to ensure an understanding of the limits of science in policy. He took it as a given that science *does* have an important role in policymaking; the key task was to ensure everyone had a good sense of what science was. However, his comments suggest a more worrying possibility: What if the role we accord scientists in policy is based on a misunderstanding about what scientists do? If policymakers and publics listen to scientists precisely because they believe that scientists can tell them "the facts", then clarifying that scien-

tists actually deal in uncertainties may not just cut scientists down-to-size, but cut them out entirely.

These concerns are hypothetical, but they point to an important possibility. Commentators often suggest that there is a difference between what publics *think* scientists do or should do, and what scientists *actually* do or should do. However, they less often consider the possibility that these false attitudes may be bound up with everyday trust in science, creating complex problems when scientists act in ways which seem in tension with public beliefs (Kovaka 2021). My aim below is to explore one way in which our everyday thinking about science might be confused, and its implications. Unlike Vallance, who thinks our problem is that we have a single false view of science, I explore a more complex possibility: that everyday talk of trust in science flip-flops between two different images of science. On the first image, the scientist is "epistemically cautious"; like a wise old Uncle in a folk tale, the scientist doesn't speak often, but when they do speak they should be taken seriously precisely because they are reticent. On the second image, the scientist is "epistemically open": like a stock-market whizz in a business bestseller, they constantly update their beliefs in response to the flow of information, providing the best available, but always fallible, estimates. Here is my worry in a nutshell: both pictures give us *some* reason to trust scientists,

but very *different* reasons, with different epistemic and political implications. Recognising this tension both helps us better understand some high-profile debates around Covid-19 and motivates a surprising positive conclusion: that we should stop talking about "the" science.

Responding to Uncertainty

It seems clear that policy should be based on the science, but what does that mean? From the start of the Covid-19 pandemic, some experts argued that facemask mandates would reduce viral spread, but other experts disagreed (Martin 2020; Greenhalgh 2020). In April 2020, the UK Government sided with the sceptics: "we do not recommend face masks for general wearing by the public" (Schofield 2020). In June, however, the Government made facemasks compulsory on public transport, and soon after extended regulations to other public spaces. According to Prime Minister Boris Johnson this change of heart was an instance of "following the science": "the scientific evidence of face coverings, and the importance of stopping aerosol droplets... that's been growing" (Wilson 2020). On the face of it, the government's justification for their policy-shift seems reasonable: if policy ought to be led by science, then, if scientific understanding changes, so, too, should the policy. What, though,

does it mean to say that the science has changed? There was more evidence for the efficacy of facemasks in June 2020 than in March. Still, the key concern of the anti-facemask scientists in March was that there were no RCTs showing facemask efficacy, and there were still no such studies by May (Wilson 2020). So, had the science changed?[1]

To clarify this problem, consider a hypothetical everyday example. Imagine you have two friends, Anna and Ben, both of whom are keen students of British politics. You ask them who will win the next election in 2029. Anna refuses to answer, saying that there are simply too many uncertainties. Ben, by contrast, gives you an answer, "I'd say probably Labour", albeit with caveats "but a lot could change in the next few years; if the budget goes wrong, I'd think probably the Conservatives; but if there's a change in the Ukraine conflict, then...". Here is one way of understanding your friends. Anna displays a virtue of "epistemic caution": she refuses to commit to any claims until she is highly certain they are correct. Ben displays a virtue of "epistemic openness": a willingness to make a provisional guess on the basis of available evidence, but to change his mind in light of new evidence.

[1]Note that the discussion in this section draws on my own earlier paper (John 2022a) but with a very different emphasis, leading to some different conclusions later on.

We tend to think of scientists as the exemplars of epistemic virtue. But, as my cartoon example suggests, there are different epistemic virtues. Which epistemic virtues do we think scientists possess? I suggest that public images of science are confused on this topic. Sometimes, when we think and talk about scientists, we assume that they do (or should) possess the first epistemic virtue, that they are (or should be) "epistemically cautious": they are the kinds of people who refuse to commit to claims until and unless they have been rigorously tested; they refuse to make commitments beyond their experience unless they are compelled to do so; and so on. I suspect this is the view which Vallance characterises as an assumption that scientists provide "facts" (metaphysical qualms to one side here); if they are doing anything else, they are not "really" scientists. It is also an image promoted by key figures in philosophy of science; consider, for example, van Fraassen's striking claim that "it is not an epistemological principle that one might as well hang for a sheep as a lamb" (van Fraassen 1980, 73). Sometimes, however, when we think and talk about scientists, we think of them as possessing the second virtue, of epistemic openness; scientists form credences on an unbiased view of the evidence, and unlike, say, religious gurus or political ideologues, they ruthlessly update their credences as new evidence accumulates. This is the model of the scientist

which Vallance seems to think is more plausible: the scientist is someone whose claims are always tentative and murky. It is also the image of the scientist associated with the philosophically unfashionable but publicly influential work of Karl Popper, with its image of endless conjectures and attempted refutations (Popper 1963).

How does this distinction between different images of science help us understand the facemask case? Jonathan Fuller has suggested that two different epistemological camps have dominated debates around Covid-19. One approach, associated with public health epidemiology, is "methodologically liberal and pragmatic", stressing the importance of using multiple sources of evidence. The other, associated with clinical epidemiology, is "more methodologically conservative and skeptical", guided by maxims of Evidence Based Medicine (EBM) (Fuller 2020). Broadly, members of the first camp were proponents of facemask use, whereas proponents of the latter were opponents. Typically, in debates over facemasks, supporters of mandates came from the "public health epidemiology" camp, stressing a range of different types of evidence for efficacy, such as observational studies from East Asia or the basic physics aerosol dispersion. Opponents tended to be from the "Evidence Based Medicine" camp, stressing that alleged support came from sources far down the "hierarchy of evidence".

Fuller is right that much of the debate over topics such as facemasks turns on questions about the *admissibility* and *strength* of different types of evidence. However, a second, slightly different concern also runs through these debates. Many opponents of facemasks were willing to admit that there was *some* evidence that they were effective; what they doubted was that there was *sufficiently good* evidence to say they were. Combined with a commitment to the evidence hierarchy of EBM, they held that we should say facemasks are effective *only* when we have RCT evidence. Strictly, their view on different kinds of evidence was separate from their general commitment that scientists should commit to claims *only* when they have the "best possible" evidence. Indeed, it is notable that many proponents of facemask mandates were happy to cede the epistemological claim that RCT evidence is epistemologically superior to—indeed, the strongest form of—epidemiological evidence (Greenhalgh 2020). They agreed that RCTs would serve as a "clincher" for facemask efficacy. (This agreement is worth stressing, given that there are independent concerns that the EBM evidence hierarchy is misguided; see Howick 2011.) The disagreement between the two sides was not so much about what counts as *better* or *worse* evidence, but over whether claims could be made in the face of uncertainty.

Of course, there was a lot going on in the debate about facemasks. Still, here is a proposal: just as I have suggested that there are two public images of the epistemic virtues of science, so, too, there are two self-images scientists might hold. On one, which we can—very loosely—associate with the facemask-sceptical EBM camp, it would be deeply problematic for scientists to "stick their neck out" and render a view on facemask efficacy in the absence of high quality evidence. On the second, which—again, very loosely—we can associate with "public health epidemiology", the scientist should not demand certainty but give her best guess, while being willing to revise that opinion as the evidence changes. It is not just that the public's views of scientists is confused, but scientists differ in their self-conception.

Who Should we Trust?

Vallance suggests a straightforward gap between what publics and policymakers think that scientists provide, "facts", and what scientists can actually provide, tentative, uncertain, provisional conjectures. I have suggested a more complex picture: both public discourse and scientists' self-image involve an image of scientists as both "epistemically cautious" and "epistemically open". In principle, there is nothing wrong with this picture, because,