12

Science and Public Policy in a Post-Pandemic World

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It is tempting to divide history into times "before" and "after" the COVID-19 pandemic, and to ask how the pandemic has changed things. For it unquestionably has. Millions have died; millions more have contracted the disease and will live with its long-term and still largely unknown consequences. The pandemic has triggered a global economic downturn that will likely last for years. It is still an open question when and even whether social life will return to "normal," with handshakes and hugs, social gatherings, and maskless mass events. There is a good chance that, like the four other endemic human coronaviruses, SARS-COV-2 is here to stay (Roberts 2021).

We can, however, also see continuity amidst upheaval. Many of the changes that we ascribe to the pandemic were set in motion long before 2020, and it is better to ask how the pandemic has arrested or accelerated those changes. Such is the case with the role of science in public life. Amidst the pandemic, scientists, science advisers, scientific knowledge, and scientific activity have occupied the public spotlight to an unusual degree. Epidemiologic models predicting the spread of the COVID-19 virus with and without public health interventions directly informed decision-makers and are hotly debated on social media. American science adviser Dr Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, is a household name, alternately venerated as a voice of scientific reason and vilified as a fear-mongering bureaucrat. Millions of people have developed opinions, however informed, on the effectiveness of different types of masks, the potential of treatments like hydroxychloroquine, and the timeline of vaccine development. And in many countries, one's position on scientific facts (are masks effective? are vaccines safe?),

and the trustworthiness of science in general, are deeply intertwined with politics and personal identity.

While the intensity of the pandemic has lent it exceptional urgency, it would be a mistake to presume that it has fundamentally changed the production and consumption of scientific knowledge – yet. The COVID-19 pandemic has accelerated and surfaced long-term trends in the ways that scientific knowledge is produced, circulated, interpreted, and acted upon. How we collectively respond to these trends in a post-pandemic world will depend in large part on our implicit models of what science is and its appropriate role of science in public life.

SCIENCE AND THE WEAPONIZATION OF UNCERTAINTY

The COVID-19 pandemic has been a double-edged sword for the scientific enterprise. On one hand, and from an historical perspective, science has unquestionably triumphed. The virus was identified, its basic biology and epidemiology understood, countermeasures implemented, and vaccines developed with exceptional speed. Notwithstanding notable exceptions, decision-makers have generally heeded the warnings and advice of scientific advisers, and successful pandemic response appears to be correlated with willingness to act on scientific advice. New Zealand's effective containment of the virus has been credited to Prime Minister Jacinda Ardern's decisive, science-informed leadership and close working relationships with the scientific community (Baker, Wilson, and Anglemyer 2020). Despite being hit by the virus comparatively early, Taiwan, Vietnam, Singapore, and Thailand mounted quick and effective science-informed public health responses. By contrast, catastrophically slow responses in the United States, United Kingdom, and Brazil have corresponded with refusals to heed the advice of science and public health advisers.

On the other hand, in the public arena science has suffered. Individual scientists have been maligned and harassed on social media; political leaders have publicly denounced science and sidelined scientific advisers; and public mistrust of science appears to be growing. A flood of scientific preprints – articles that are publicly posted without undergoing peer review – has been cited as contributing to the spread of COVID-related misinformation. But peer-review is no panacea: two of the world's premier medical

journals, *The Lancet* and *The New England Journal of Medicine*, retracted widely-publicized studies of potential COVID-19 treatments on the same day (Joseph 2020). These developments and more have shaken the traditionally unassailable authority of science in public policy.

Of particular note is the role of uncertainty in the interface between science and public life. A principal weapon in the populist arsenal is to proclaim absolute certainty, celebrating the authority and personal charisma of a powerful leader, while demeaning other sources of evidence. Certainty is an indication of power and control, uncertainty a risible sign of weakness rather than an indication of an honest appraisal of the situation. One of the Trump administration's first public acts was to repeatedly double down on claims that his inauguration was the largest in history, despite decisive photographic evidence to the contrary (Swaine 2018). This display of power over subordinates and willful ignorance of the facts was simply the first in a long series of steps towards the Trump's administration's catastrophic handling of the COVID-19 pandemic (Levy 2016).

Along with the celebration of certainty comes a demonization and weaponization of uncertainty. A principal tactic in the weaponization of uncertainty is to insist on impossible levels of certainty to justify changes to the status quo, and disparage one's opponents when they cannot provide it. While tobacco companies, climate change deniers, and other "merchants of doubt" have covertly employed this tactic for decades (Oreskes and Conway 2010), during the COVID-19 pandemic it has been employed openly and repeatedly in attacks on epidemiologists who revise their COVID-19 mortality estimates in light of new information about current interventions (Wan and Blake 2020).

THREE WAYS FORWARD

What is the best way to respond to the apparent crisis of confidence in science and attendant weaponization of uncertainty? The answer to this question depends upon one's implicit model of science and its proper role in public life.

One model, which is arguably the most prevalent among scientists themselves, holds that science is a set of principles and methods to accurately describe, explain, and predict what will happen in the world – and policy must be made on the basis of accurate descriptions, explanations, and predictions. A recent US National

Academies of Science, Engineering and Medicine report thus defines science as "a mode of inquiry that aims to pose questions about the world, arriving at the answers and assessing their degree of certainty through a communal effort designed to ensure that they are well grounded. Scientific inquiry focuses on four major goals: (1) to describe the world (e.g., taxonomy classifications); (2) to explain the world (e.g., the evolution of species); (3) to predict what will happen in the world (e.g., weather forecasting); and (4) to intervene in specific processes or systems (e.g., making solar power economical or engineering better medicines)" (National Academies of Science, Engineering and Medicine 2019).

Under this model, scientists are distinguished not by particular attributes or dispositions, but rather by sharing a set of common assumptions (that the world is consistent and governed by discernable and quantifiable rules) and adhering to common methods of producing knowledge (hypothesis formulation and testing, continual modification of theories in light of new evidence, characterization and communication of confidence and uncertainty, aggregation and synthesis of knowledge, and working towards consensus). Scientists are accorded special authority because these assumptions and methods produce accurate, reliable, objective, and useful knowledge. This is the basis of the "evidence-based policy" approach which, as one Canadian government report argues, "levers the best available objective evidence from research to identify and understand issues so that policies can be crafted by decision makers that will deliver desired outcomes effectively, with a minimal margin of error and reduced risk of unintended consequences. Compared to subjective values, the factual interpretations of special interests and advocacy groups, and selective or ideologically-driven viewpoints informing the policy development process, an evidence-based approach has as its great advantage neutrality and authoritativeness. This stems from sound, rigorous, comprehensive and unbiased policy research" (Townsend and Kunimoto 2009).

A second model holds that scientists are objective, neutral, unbiased, and able to distinguish that which is a matter of "fact" from that which is one of perspective, ethics, or emotion – and policy must be unbiased, objective, and unemotional. As political economist William Davies notes:

> According to the ideal of modern science, scientists are unlike members of a crowd or political figures, because they are able

> to separate their feelings from their observations. They are able to distinguish that which is a matter of "fact" from that which is one of perspective, ethics or emotion. They can do so because they are able to park their own identities when they enter the laboratory or field, and act merely as neutral mediators between the data that they collect and the documents that end up in journals … Scientists seek our trust and respect because they promise to represent things accurately … To trust in science is to trust in the capacity of people to report and record things in an adequate fashion, and to leave their own biases and emotions at the door. (Davies, 2018)

While it shares the first model's emphases on objectivity, neutrality, and accuracy, this model shifts the emphasis from the methods of producing knowledge to the attributes and dispositions of the people who produce and disseminate it. This distinction is crucial when considering the role of science in public life. Under the first model, decision-makers should accord science a special role because it produces the most reliable and accurate information for policy purposes, thus reducing the biases inherent in human judgment. Under the second model, decision-makers should accord scientists a special role because they are special kinds of people, able to free themselves from the biases and emotions that cloud others' judgments.

The COVID-19 pandemic has demonstrated the limitations of each of these models of science. While in the long term the scientific method may produce knowledge that is relatively more accurate, reliable, and useful, in the short-term it has to wrestle with the same uncertainties that all forms of knowledge-production confront. Legitimate disagreements over the effectiveness of different kinds of masks, the R-naught of the virus, the effectiveness of different interventions, and the appropriate assumptions for modelling the spread of infections have all illustrated the fact that at any one time, even the best scientific methods may fail to produce knowledge so reliable that it makes policy decisions self-evident. This is a feature, not a bug of the scientific method: it recognizes the inherent instability of knowledge, and thus the necessity of subjecting all models, theories, and claims to continuous scrutiny and updating. Yet if public trust in science depends upon the absolute infallibility of the knowledge that it produces, then it will always be open to the charges of fallibility that are central to the weaponization of uncertainty. Model One is unsupportable.

Model Two fails for the simple fact that we cannot and should not anoint individuals as infallible, unbiased purveyors of fact. Scientists may indeed aspire to "park their own identities" when they enter the lab, engage in public debate, or advise decision-makers on the best response to the pandemic; but in practice this is an unattainable ideal. Again, this is a feature rather than a bug: at their best, scientific methods seek to reduce bias and characterize uncertainty precisely because humans are fallible and uncertainty is ubiquitous. And, as with Model One, if public trust in science depends upon the absolute infallibility and objectivity of scientists themselves, then they will always be open to legitimate and illegitimate charges of bias and fallibility that are central to the weaponization of uncertainty.

It is commonplace to lament the "politicization of science" during the COVID-19 pandemic. Authoritarian rulers like Trump and Bolonaro have indeed politicized science by demonizing scientists and scientific institutions, promulgating misinformation and disinformation, and promoting themselves as infallible and authoritative sources of information, often directly contradicting established scientific and public health authorities. Yet the lamentation is best read as a sign that Models One and Two are not (or are no longer) sustainable. Ultimately, the demystification of science during the COVID-19 pandemic presents an opportunity rather than a barrier to advancing the role of science in public life.

A third model of science and its role in public life holds that science is a value-laden, historically-contingent, context-dependent form of producing knowledge, which has no special claim to infallibility, objectivity, or efficacy – but whose values are the best foundation for policy. This model insists on recognizing the scientific enterprise both as it is and as it aspires to be, without mistaking the latter for the former. The scientific enterprise can be lauded for its aspirations to objectivity and infallibility, and the values that guide those aspirations, without believing that the scientific method or individual scientists perfectly embody those aspirations. As historian of science Naomi Oreskes has argued, "in suppressing their values and insisting on the value-neutrality of science, scientists have gone down a wrong road. They have made the mistake of thinking that people would trust them if they believed that science was value-free" (Oreskes 2019). Similarly, sociologists

Harry Collins and Robert Evans insist on "looking at science as an institution that can give moral leadership [...] democracies need science because science is, or can be, a fountainhead of good values. Science's understandings are continually disputed, but science's values are eternal. Thus, whatever position one takes on the value of science's outputs – and most people will still reach for truth and utility when justifying science – the argument from science's values will stand" (Collins and Evans 2017).

The values most closely associated with science were first elucidated by sociologist Robert K. Merton in the mid-twentieth century. Merton identified four "institutional imperatives": "communism" (scientific knowledge is the property of the scientific community as a whole, in order to promote active sharing and cooperation); "universalism" (science may be practiced by anyone, regardless of race, nationality, gender, or culture, and adjudication of knowledge-claims should be entirely impersonal); "disinterestedness" (scientists and scientific institutions should act for the common benefit, rather than for personal gain); and "organized skepticism" (scientific knowledge should be subject to continuous scrutiny and robust debate; Merton 1973). To these institutional norms we may add "transparency and openness" (scientific knowledge, and the processes by which it is produced, should be fully available for public review); and "comfort with uncertainty" (scientific knowledge should characterize and communicate confidence and uncertainty).

Taken together, these values accord well with broader democratic ideals of inclusion, openness, and transparency, and can inform the institutional design of science, justify the place of science in public life and policymaking, and offer one means of counteracting the weaponization of uncertainty. We should embrace as a virtue science's unique commitment to understanding, quantifying, and communicating uncertainty. The best predictive models provide best- and worst-case scenarios, and are revised as new information comes to light; the most trustworthy sources of information transparently and unflinchingly communicate uncertainty; and the best decisions flow from understanding and embracing uncertainty rather than denigrating it and proclaiming false certainty (Manski 2013). Democratic institutions in the post-pandemic world should take these values as central organizing principles.

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