Science and its Public after the Pandemic

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Who would have thought it? People all over the world, most of whom had happily forgotten whatever they'd learned about science and mathematics in school, were suddenly tuning into broadcasts and podcasts by virologists, epidemiologists, physicians, and geneticists, following the Twitter feed of doctors and nurses on duty in intensive care units, and obsessively washing their hands as they sung "Happy Birthday" (twice) under their breaths. They willingly, indeed avidly listened to explanations of R_0, exponential curves, case/fatality ratios, and many other concepts that would have put them to sleep in seconds only a few weeks before. The Johns Hopkins University Coronavirus Resource Center website, bristling with maps and graphs and data, was bookmarked on hundreds of thousands of computers. Heads of state gave press conferences flanked by scientists, to whom they regularly deferred, and promised to be guided in their decisions about how to fight the new virus by "science and the data". All the hand-wringing discussions about the growing distrust of science as evidenced by climate-change deniers and vaccine objectors vanished almost overnight from the airwaves and the newspapers. Terrified by the specter of the COVID-19 pandemic, the public looked to science for its salvation.

It's worth recalling just how anomalous this moment of voracious curiosity on the part of the public and daily communication on the part of scientists in the relevant specialties is. With the possible exceptions of astronomy (all those technicolor images of galaxies and black holes) and ethology (the perennial appeal of natural history films), most laypeople's attitude toward the sciences has been at best indifference and at worst hostility. Oddly, the countries in which high school students show the least inclination to continue studies in science and

mathematics are arguably the ones that have profited most from these disciplines: the Norwegian-based Relevance of Science Education (ROSE) project found an inverse relationship between level of economic development and students' desire to learn more science, with Ugandans most eager and Norwegians least (https://roseproject.no/network/countries/norway/eng/nor-sjoberg-apfslt2005.pd). As for the scientists, despite recent efforts to counteract exactly the apathy documented by the ROSE study by more public outreach, their preferred mode of communication is to fellow specialists at conferences or in peer-reviewed journals. No one was more astonished than the virologists who conduct the shop-talk podcast *This Week in Virology* (https://www.microbe.tv/twiv/) to see the number of downloads skyrocket from 20,000 to 500,000 in the first quarter of 2020 and to receive anxious questions and adoring fan mail from new listeners (https://www.thaliagig.com/twiv-goes-viral). We are living in a state of exception in more ways than one.

Is this too good to last? Should it last? What do science and the public stand to lose and gain from their intense interactions during the pandemic?

First, the scientists: Pleasing though it must be for virologists, epidemiologists, and other biomedical researchers to find both politicians and the general public hanging on their every word, not to mention a gusher of research funding and the I-told-you-so satisfactions of having long warned the world in vain about the probability of just such a pandemic, the scientists most exposed to the limelight quickly discovered the nastier side of celebrity. They were understandably offended by personal abuse in the media (especially the troll-infested social media), and still more by what they perceived as an intolerable mix of science and politics. Time and again they struggled to separate knowledge and belief, but at least two factors made their task more difficult. First, as soon as politicians publicly ceded decision-making in the crisis to scientists ("We are following the science."), science became *ipso facto*

politicized. Leaders confronted with thorny moral dilemmas – save more lives at the price of ruining livelihoods? – were all too happy to shift the responsibility to other shoulders, and the politically inexperienced scientists bore much of the brunt of the wrath that was bound to come from those disadvantaged by emergency policies.

Pushed onto the public stage, scientists discovered that the uncertainty and disagreements that are an essential element of all scientific inquiry, carefully assessed in error analysis and debated in the pages of specialist journals, could be exploited by factions seeking support for their own views or simply to undermine all authority. Here the far Right and the far Left made common cause, to the dismay of most scientists. Because science journalists habitually erase all the uncertainty that surrounds the new results they report, the majority of readers were disagreeably surprised to discover from real-time coverage of science-in-the-making that scientists often disagreed among themselves about the reliability and interpretation of what data existed. Precisely at the moment when the public craved scientific certainty, they were confronted with scientific uncertainty. The uncertainty was of course amplified by the novelty of COVID-19 and its bewildering spectrum of clinical manifestations, from barely noticeable to deadly. Also, the urgency of the moment lowered the threshold for going public among scientists. Suggestive results that might not have survived peer review were hastily posted as online preprints and widely cited by journalists. Science in the fast lane can be treacherously uncertain. But all science is and must be fringed with uncertainty: if it were not, it would not progress.

Second, the public: Ultimately the responsibility for political decisions in a democracy rests with its citizens, and during the pandemic electoral choices have come home to roost. People all over the world could compare death rates between, say, the United States and Canada, or the United Kingdom and Germany. Although every analysis must remain provisional until the pandemic is behind us and all the data is in, so far these comparisons do not bode well for

populist governments. The fates of nations have also stoked the debate over whether authoritarian states like China or democracies like South Korea have protected their citizens better in a crisis – and also whether the form of government matters less than the quality of leadership. The point here is that the data about the pandemic has created a new kind of scorecard by which citizens can rate the performance of their governments – and also focused public attention on whose official data can and cannot be trusted. Whatever reservations the scientists may have about the strict comparability of the statistics, comparisons are being made by almost everyone on a daily basis.

Moreover, the public consciousness has been sharpened not only for numbers but also the reliability of numbers: whether it is deaths with or from the virus that enters the official count; the false negative and positive rates of antibody tests; the difference between case-fatality ratios and deaths-per-100,000 people. People have always been numerate in the areas of life they care about, whether it's mortgage rates or sports statistics; now they care fervently enough about public health statistics to pay close attention.

Finally, the public has observed the contrast between the international community and the scientific community. Whereas nations by and large responded to the crisis by closing borders, hoarding essential supplies, and pointing fingers at each other, even within the European Union and among the states of the U.S.A., scientists by and large responded by sharing data and cooperating. The latter response cannot be taken for granted. As one London-based scientist working to combat the virus remarked (https://www.lrb.co.uk/the-paper/v42/n10/rupert-beale/short cuts?utm_campaign=4210&utm_content=ukrw_nonsubs&utm_medium=email&utm_source=newsletter): "We are part of an effort that extends across the world: I have never encountered such openness and generosity among scientists (we're a competitive bunch)." The real international community turned out to be the scientific community.

What lessons will the scientists and the public draw from their super-charged encounter once the pandemic is over? It's all too possible that they'll just lapse back into mutual obliviousness. Lay people will lose interest in virology podcasts; scientists will return with relief to their labs (those currently most in the public eye are already complaining that the time spent enlightening the public is time stolen from reading the latest publications). But this would be a missed opportunity on both sides.

The scientists are badly in need of a more sophisticated way of thinking about the relationships between science and politics. Protestations of purity are ineffectual in situations in which politicians must rely on scientific counsel to make consequential decisions. All parties – scientists, politicians, citizens – need more practice in distinguishing between the scientific and political components of such decisions, as well as in discerning where the distinction is blurred. This is only partially a matter of transparency; it is also a matter of critical reflection and a frank acknowledgement of the risks involved. Scientific knowledge is the best knowledge we have, but it is not and cannot be certain knowledge.

The public for its part is badly in need of an education, both intellectual and moral, in uncertainty. Intellectually, this would mean a better understanding of how science domesticates but does not eliminate uncertainty: if laypeople could figure out R_0 in a matter of weeks, there's no reason why they can't also learn the meaning of error bars, confidence intervals, and the other checks and balances instituted to gauge the reliability of scientific claims. We don't all have to become scientists, but we do have to become scientifically literate citizens. The moral component of this education will be harder: we must wean ourselves of our addiction to certainty. The past few months have been a brutal lesson in just how uncertain life can suddenly become. Yet to an admirable degree the vast majority of people coped with the fact that their world had been turned upside down and inside out. Accustomed to planning our lives months in advance, we learned to live with a foreshortened

future horizon of only a few days. The real challenge will be to hold onto this lesson learned once life again becomes predictable – predictable, but not certain.