26 Public Confidence in Science

Building Trust on Understanding Scientific Method and Uncertainties

Interview With Aaron Mertz and Abhilash Mishra

Introduction

Public acceptance and confidence in science loom as a significant issue in Australia, not least because of the responses and acceptance of COVID-19 pandemic issues and the restrictions imposed on our society.[1] Before that, we had the issues of climate change which raised many questions about public confidence, trust and understanding of science, and in communicating science.[2] These issues also loom large in the United States of America from where we might glean some understanding and lessons about public understanding of science.[3]

Keywords: agribusiness; agriculture extension service; AI; Amazon deforestation; American Science Corps (ASC); anti-vaxxers; civic science; climate change; climate deniers; cognitive dissonance; communications training; community participation; COVID-19; COVID-19 masking; deficit theory; diploma divide; journalists; land-grant colleges; partisan politics; political leadership; public confidence; public trust; science communication; science education; science ethics; science journalism; scientific information; scientific method; scientists; SDG 4; SDG 16; SDG 17; trust; trust mechanisms; uncertainty; universities; vaccine hesitancy

Interviewee Profiles

Dr. Aaron Mertz (**AaM**) is the Founder and Director of the Aspen Institute, Science and Society Program, Yale University, New Haven, Connecticut where he gained his doctorate in Physics. Dr. Abhilash Mishra (**AbM**), founding Director, Initiative on Science, Technology and Global Development, Harris School of Public Policy, University of Chicago is a scientist, entrepreneur and educator

The Interview

ML: Aaron, late last year, you held a one-off event on the future of science,[4] and more recently you hosted a substantial global connection and

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hook-up on communicating science.[5] Why was it a good time to be looking at the future of science?

AaM: Over the past several years, especially in the United States, many aspects of science have become very politicised and seen in ideological terms.[6] Science, in my view, has always been political, especially in the United States because it's largely funded by our government.[7] When it starts to be seen as a tool for just one part of our country, I think that's what we were responding to. I'm having these broader conversations about what role science should serve for our population, both in the United States and more globally.[8]

ML: What have been the trends in polling about society's understanding, acceptance and confidence in science?

AaM: It's been fairly consistent over the past few decades based on various polls that we've examined, and it hovers around 47%, so I would not say that's particularly high. That means we have about half of our population that is distrustful of the scientific process and its products.[9]

ML: What does the polling tell us about the demographics of public confidence and acceptance in science?

AbM: There's a clear 'diploma divide', which is that folks with a college degree and higher levels of education show greater trust in science; and folks without a college degree show lesser trust in science, which is not surprising.[10] But I think there's something deeper going on here. It's not just that they have trust in science, they just have a lack of trust in institutions and I think science is just a case in point. I would say, generally, that the demographics are clearly along the 'diploma divide' here in the United States.[11]

ML: Is political partisanship an indicator of levels of acceptance of science?

AbM: There again I see significant differences between Democrats and Republicans in the broad trust indicators. For example, a regular poll shows Democrats consistently trusting the science behind climate change at 30 points above Republicans, so there's clearly a huge overall partisan divide there.[12]

As a rejoinder to that statement, I would say that it's unclear how significant this partisan divide is because the leadership in particular parties are pro-science and anti-science, as against people overall being pro or con science. We saw this in the mask-wearing debate. Because leaders did not buy into the science behind masking and were peddling pseudoscientific medicinal theories,[13] a lot of people who followed a particular party or that particular leader adopted unscientific beliefs. It is unfair and probably not appropriate to dub Republicans as anti-science and Democrats as pro-science, but there's definitely a clear divide between the two.

ML: So leadership is a factor in the partisan and political dimension, in that political leaders have a big influence. Do we draw the conclusion that people's attitudes towards science depend upon party political positioning?

AbM: Yes, absolutely.

ML: That puts a lot of responsibility on political leaders, doesn't it, to understand and communicate science?[14]

AaM: Yes, and not just communicating science from the perspective of an ideology but also communicating the method and process of doing science, its nuances. Dr. Anthony Fauci, Director of the NIH, is an example of someone who has truly tried to communicate the nuances of science in the pandemic, which I think is a great example of a scientific leader,[15] as opposed to going out there and saying 'I'm pro-science' or 'anti-science'. That doesn't really help the cause.

The role of leaders is to communicate the assumptions and the style of doing science that most people don't think about in their day-to-day lives. Early in the pandemic, the guidelines according to the science at hand were that masking was not necessary because at the time we did not know about asymptomatic transmission of COVID-19. Then, as we got more data and learned that there could be many carriers of COVID-19 who are transmitting the disease without a mask, then the new guideline was to wear a mask whether or not you're symptomatic and whether or not you're sick.

A lot of people interpreted that as bad 'flip-flopping' science when the messaging needed to be that this was actually science doing its job in responding to the data at hand, and revising the conclusions based on the new information that came in. I think it was on the leadership to say it's not that science is wrong or inconsistent, but that science is always reactive and evolving based on evidence. It's a continuous process, and I think that's where leadership needs to step up and communicate.[16]

ML: This highlights the question about the understanding among the public, and in the community, about the nature of scientific method and the related questions of uncertainty, knowledge and truth within the scientific method. I believe the polls generally show that those who have more knowledge of science, and the scientific method, tend to be more accepting and confident in science; whereas those who don't understand or know science, and its method, are less accepting.[17] Is that correct?

AaM: Absolutely, and what we've seen from research in psychology and sociology, is that understanding the process of science is actually the best way for people to be able to change their minds about long-held

beliefs, even when they're in conflict with their personal, religious or family ideology.[18] It's not about bombarding them with new facts, data and statistics, but actually conveying to them the process of science.[19]

ML: Where do the responsibilities lie to get higher levels of understanding of the scientific method among political leaders and the general public?

AbM: It's important that scientists themselves recognise how we communicate science.[20] Often we scientists, especially when talking to the public at large, talk about science as 'the truth', whereas it is actually just a way of looking at the world and an ever evolving sort of toolkit through which we parse the world. That is the nuance that often gets missed when scientists talk in public. That pivot in communication is very urgently needed if we are to get people not just to be scientifically knowledgeable in terms of knowing a bunch of facts but also to think scientifically and to be able to deal with scientific uncertainty in a meaningful way.[21]

ML: Do scientists themselves have a significant responsibility for communicating the nature of science and the scientific method more generally?[22]

AbM: Absolutely, yes. It is important that scientists communicate the fascinating discoveries that we make and the facts of science. But it is even more important to communicate the method of science and the uncertainties around generating and developing scientific information. I think this eventually goes towards building trust in science, by acknowledging that scientific knowledge comes with a lot of uncertainty and that there's a systematic way of dealing with it. Uncertainty is a very important part of building that trust, which otherwise is not going to be built if we just go to the public and say here is a bunch of facts, here's the truth, accept that.

AaM: I agree and want to add that I think it's the duty of scientists to play that public role. As I mentioned earlier, science in the United States is largely federally funded by taxpayers' money. So I think there should be a public component to their work but they also need training on how to do that. It's something that is largely absent from the scientific training that we receive as graduate or postdocs:[23] how to boil our message down into an understandable format that's relevant to people's lives; how to convey the uncertainty and the scientific method that Abhilash just mentioned. So before scientists go out and do that work, they need to learn how to do so properly.

ML: Perhaps scientists are not skilled in communication because their main emphasis is on doing research and on communicating with their peers for peer review, evaluation and knowledge building, rather than speaking to a broader audience. This involves not only skills but a question about their access to resources to do that and their ability to get their

messages out, even assuming that they're able to communicate in a good form. In these days of controversial media and social media issues these are highly contested domains in which to be trying to operate, aren't they?

AaM: It is and you raise a very important point that at least in the United States there are not a lot of incentives for scientists to do this kind of work. As you mentioned, there are so many other constraints on doing their research, writing articles that have to be peer reviewed, contributing to their writing to the community, and the incentives from universities are not there for them to go out and do this public engagement.[24] Towards that end we recently made a public proposal.

AbM: Aaron and I recently wrote an op-ed for *Science* magazine which called for the creation of an American Science Corps (ASC),[25] which would be a fully funded federal programme that would place early career scientists in communities that are traditionally not scientifically engaged. So think about rural communities and underserved communities which might not have access to scientific expertise. The proposal was to take early career scientific talent and place them in these communities so that they can pursue two big goals. One is to build public trust in science; and the second is to train communities that might not have access to a college education in skills that are relevant for the twenty-first-century innovation economy.

ML: We've been hearing in recent times out of India about the issues confronting the transformation of agriculture and the huge protests from the farming communities' right around the country against those reforms.[26] To what extent, if any, would you see the sort of points you're making as relevant to that sort of debate?

AbM: Part of the challenge in the Indian context was the lack of participation of communities in policymaking. A lot of conversation globally is about 'evidence-based' policymaking, which is the idea that policies, whether economic, social or scientific, should be driven by evidence which makes intuitive sense among scientists.[27]

What we sometimes forget about is who gets to have a say and who gets to participate in the evidence building itself. I think what we saw in India was a fracture in trust in terms of who is making the policies and who it was affecting.

The goal of the American Science Corps is to better foresee those kinds of fractures if we do not involve communities in the process of policymaking. But we need structures to enable that and one of the ways to do that would be through this American Science Corps. It's interesting that you bring up agriculture, because the ASC proposal is based on the US Agricultural Extension Service,[28] which was a

policy innovation in the early part of the twentieth century. It brought together academics at land-grant universities and farmers creating this network between the two, which led to a highly cooperative way of doing research and innovation.[29] We need a similarly new institutional structure like the ASC which goes back to these cooperative roots in the way of doing science and technology together for the larger public good.

ML: Abhilash, this raises the question of power in science policy decision-making because in that context, as distinct from research, what we see is the involvement of many vested interests.

I'm thinking particularly of the climate change debate and before that, of course, we had the tobacco debate – where public perception of science and scientific evidence was thrown into huge doubt by big money campaigns from vested interests.[30] Where does this fit into your picture of how we can build better public acceptance and understanding of science?

AbM: What you're describing is a much deeper challenge of who gets to shape the conversation about science. Obviously, there are challenges around who funds scientific research and information campaigns and whether they might be biased by commercial interests. That is why I think an agency or a mechanism by which you have a truly democratic process of communicating science, which is not driven by commercial or partisan interest but is there just for the public good, is essential. That was the big animating vision behind why we need something like an American Science Corps.

AaM: We hope that initiatives like the ASC and work being done by others in the field of 'civic science'[31] will help diversify the pipeline of individuals going into science policy and research, and also into those big invested stakeholders who can have a big influence across different sectors. In that way, we're hoping that in the future we'll see more voices at the table that have been absent from previous discussions about the role that science should play in our society.

ML: Abhilash, you mentioned in the context of agriculture, the importance of the extension-type service ideas that were around in the public interest in earlier decades of the last century. Australia pioneered and had strong agricultural extension networks that drove huge increases in productivity off the back of public research. However, we don't have that system of public extension anymore.[32]

What we do have is a privatised model where the big agricultural conglomerates and their agents, whether it's in machinery, seeds, chemicals or fertilisers, are the people now disseminating and purveying extension and advice about science in agriculture.

AbM: Yes, a similar trend has been observed here in the US and actually, my understanding of the Agricultural Extension Service came from my work in global development. Many Americans don't know about the Agricultural Extension Service primarily because agriculture has become an enterprise with a smaller number of people involved. The Extension Service which was a prominent part of the land-grant universities has been replaced by other research priorities at those universities.[33]

What has been lost in the process, however, is the central ethos of taking the university to the people, which was the core vision of the extension programme. The goal of the federal government in establishing these universities, through land grants, was that these universities in return would provide public goods through their extension programmes. We need similar approaches now for the science that is being developed at these universities to provide public goods to the community in cooperation with the community. That again requires appropriate institutional structures, and it's probably time to revive some of those older structures that existed and were hugely successful in the past century.

ML: How do we confront issues that have again arisen strongly in the COVID-19 context but which we also saw surfacing strongly in the climate context, of large bodies of public opinion, that could be characterised as 'deniers'. These people seem to have a complete set against science, with perhaps different views of the world, whether they're moral, ethical or political. We're seeing it here in Australia and around the world not so much as 'anti-vaxxer' denialism itself, but in the form of 'vaccine hesitancy'.[34] In respect of these deeply in-bred, almost pseudoscientific, anti-scientific bodies of thought in the community, what are the appropriate responses to these positions and from whom?[35]

AaM: It's very important to try and this is a really good point. There are two ways to approach it. When it's something so egregious and imminently of harm to others, we need to try to shut it down immediately. But it's different when people are coming from their own belief system and are genuinely concerned about their families' health and well-being.

When we talk about 'anti-vaxxers', there are a lot of parents who want the best for their children. The best approach is to listen to where they are, meet them where they are, and then talk about the issues through stories and through emotion.[36] These are the ways that people can really connect with something that is generally very abstract when it's rooted in data and statistics, and biology and physics, and so on.

AbM: In the past two decades, we have had a lot of optimism and enthusiasm about access to information, and access to scientific information is very easy today. But we need to distinguish between the fact that access to information does not ensure trust in information. Trust fundamentally

relies on interpersonal connections. It involves face-to-face communication. The dynamics of building trust is fundamentally different to simply accessing a website where you might get a bunch of information.[37]

So it's also important for us to recognise that often – when we talk about scientific distrust – we are puzzled by the fact that while there's so much information out there saying that vaccines work, why don't people believe it? We are baffled because we do not pay attention to the trust mechanisms that are essential to believe in this information which is a whole different game than merely accessing information.[38]

ML: Artificial intelligence (AI) and data raise important issues and questions of ethics and morality, ranging from surveillance through personal data and control. What's the role for public policy, in regulating and getting the messages out about these AI ethical domains?

AbM: We are just starting to see what happens when the public does not trust data as we have seen, for example, in the case of information around COVID-19. This kind of distrust is going to accelerate when we start using data to recruit people and to test who needs to be admitted to a hospital.

There's already a lot of evidence that the way in which artificial intelligence systems are built today are extremely biased, and that bias is automatically going to lead to distrust in these tools in the first place.[39] If we truly want to achieve the potential of AI in the next two decades, it is absolutely imperative that we build trust in these tools. A tool is not useful if people don't use it and people are going to use it only if they trust it, and the way in which people will want to trust it is by making sure that these tools are unbiased and not unfairly treating people.

For that, we need public policy and a mechanism by which AI tools that are deployed in the market are using data and ethical ways and making sure that they are heterogeneous enough in their training datasets so that they can be fair and unbiased. A step in the direction you raised is coming up with a policy to regulate AI algorithms. I believe a controversial memo about such was leaked yesterday.[40] Public policy has a huge role to play in making sure that people trust AI, because unless and until people trust AI these tools are going to be useless.[41]

ML: Data and information isn't necessarily knowledge. What is the role of journalists and the media in communicating science?[42]

AaM: Journalism has a very important role in providing rapid, on the fly, information to the public while acknowledging that this information might be in flux. We see this with COVID-19 where there are potential treatments or possible interventions, and then just yesterday in the United States, the Johnson and Johnson vaccine was put on hold.[43] Conveying to people thoughtfully and carefully the thought and regulatory processes that go into those decisions is extremely important.

The main point I want to make is that science is not a complete endeavour that's all wrapped up and tied with a bow. It's an ongoing endeavour, a pursuit of new knowledge and then applying that knowledge towards the public good. It evolves and it changes and it's really important for journalism to convey those changes thoughtfully and to talk about uncertainty in a way that the reader can understand.[44]

ML: Gentlemen, you've used the phrase 'standing up to power' during your global congress on communicating science. When it comes to building public acceptance, confidence and understanding of science – what does that mean? Who's got to stand up to power and how?

AaM: All of us need to 'stand up to power' and have the confidence and courage to call out entities and activities that are not consistent with our values and with science. The conference that you were referencing took place about a month ago. We drew together a wonderful network of about 100 science communicators and advocates from over 50 countries.[45]

Our keynote speech was given by Mariette DiChristina, who's the former editor in chief of the magazine *Scientific American*.[46] She was in conversation with Ricardo Galvão, who is a Brazilian physicist, who stood up to power for science by calling out the Brazilian government, and specifically President Bolsonaro, for not listening to the data that were showing the devastating effects that were harming the Amazon rainforest.[47] As a result, Ricardo lost his job over standing up to power and standing up for science. That was the discussion about how we all have to 'stand up to power' whether we're coming at it from the vantage point of a federal government position, as a scientist or as a layperson.

Conclusion

The experiences with climate change and COVID-19 highlight that a key to building public trust and confidence in science is communicating the nature of the scientific method, its uncertainties and risks. Science's ongoing assessment and reassessment of 'the truth' in the light of newly available data must not be misunderstood as the equivalent of political flip-flopping, as characterised by changing decisions on masking and vaccines.

The access to, and provision of, scientific data and facts is important but in themselves although now widely available through internet and online sources on the assumption that this can fill some knowledge 'deficit' on the part of the public is not sufficient.[48]

In addition, it is necessary for scientists and those that they advise to participate in an ongoing conversation or dialogue that not only addresses the diversity of situations, values and emotions in the community but seeks their

active engagement and participation using multiple communication channels. Talking at people does not bridge their 'cognitive dissonance' gap even among sustainability scientists themselves and risks their disengagement or even alienation.[49] A new model of community-based cooperative research, development and extension may be required.

Scientists have a social responsibility to communicate their work for the 'public good',[50] but they need appropriate training, incentives and institutional support. At times of crisis and political divisiveness, they may need to 'stand up to power'. Science journalists have a vital information role particularly during crises and are challenged by new media in building engagement and trust with their readers. Science has always been closely involved with politics, and politicians have a responsibility to both heed scientific expert advice in policy-making and without being tempted to use scientific advice as a cover for their own responsibilities. Emerging concerns about bias inherent in AI algorithms demonstrate how easily public trust can be eroded and how dependent it is on the development of effective government regulations.

With traditional political demographics now fuelled by an emerging strong 'diploma divide' based on levels of education,[51] building public trust in science is proving even more challenging in an increasingly polarised and partisan political climate.

Notes

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