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Science to the Rescue?

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Abstract

During difficult times, many argue that science will come to our rescue. Investment in science, technology, data and innovation are seen as vital if we are to tackle the most pressing concerns facing society. But not everyone shares this enthusiasm for science - whether it is anti-vaxxers or climate deniers, the rise of populist views that seemingly reject the rationalism of science is evident. This is not a public rejection of rational thinking though, but stems from a growing difference in the way that people experience the effects of science and technology. Rather than any perceived crisis of trust, accounting for differences in the way technology is shaping our worlds should be our biggest source of concern.

Bio

Associate Professor in Science and Technology Studies at UCL, Fellow of the Alan Turing Institute. Melanie's research looks at the role of technologies in increasing inequality and how such social impacts affect public perceptions and ethical evaluations. Previously she was an advisor in UK Government and a Fellow in Science, Technology & Society at Harvard.

During the COVID-19 pandemic, the sight of Boris Johnson, then the British Prime Minister, standing shoulder to shoulder with the Government Chief Scientific Adviser and Chief Medical Officer became an almost iconic sight for the people of the UK. At 5pm every day, we would tune in to see them in a row, resplendent against a Union Jack backdrop at the Downing Street press conference, as they ran through a series of slides showing graphs of the latest infection rates, death rates – and eventually vaccination rates. We heard the Prime Minister promise to 'follow the science" or to make decisions based on "data not dates". When people were allowed to meet, discussion of technical terms like r-rates and the difference between t and b cell mediated immunity became commonplace. Given that a few short years ago, during the 2016 European Referendum campaign, the UK's then Secretary of State for Education claimed that "we have heard quite enough from the experts", you could be forgiven for thinking that the British Government and public's relationship with science had had quite a turnaround in the face of the pandemic.

However, despite the effectiveness and safety of the COVID vaccines, the UK has seen the highest refusal rates amongst the very communities hardest hit by the pandemic. This comes amidst a long history of campaigns to oppose technologies, ranging from nuclear power, GM foods, even to 5G mobile phone masts. Around the world a similar pattern has emerged, with science on one hand being relied upon to guide policy through the pandemic but on the other hand treated with suspicion by groups who refuse to be vaccinated, or deny humankind's role in causing climate change, for instance. Even in the context of a global pandemic, the relationship between science, technology, the public and politics is complex – in the UK and around the world.

Given science and technology's potential to improve our lives and help us tackle some of the pressing challenges facing us, getting this relationship right seems one of the crucial challenges in the 21st Century. So how can we make sense of its complexity?

To begin, I would like to take you with me, back to an extraordinary experience I had back in 2005, when I had the privilege of standing for election to the UK Parliament. For six weeks I spent every waking hour talking to voters on the doorstep, at school gates, in community centres and church halls. At the time, framed as 'the information economy' and driven in

part by significant investments in digital technologies, the UK's economy was growing. Mortgage rates were at historic lows and the Government was investing record amounts into public services. Yet voter after voter told me that that couldn't be true. Many went as far as to accuse me of being a liar, because it was clear to them that things were actually getting worse. Regardless of the official figures, they did not feel better off.

I found these conversations perplexing, given the official figures in our candidate briefings. But realising that there was nothing I could say that would persuade people that things were as the statistics showed, I stopped talking and spent my time listening. And the stories people told me revealed how my neighbours were experiencing the economy in the real world, beneath the veneer of GDP or growth rates: The woman who took a daily three hour bus trip across London to care for her elderly parents and who felt trapped because that journey meant she couldn't work enough hours to save money to move closer to them; the young man feeling hopeless in a zero hours job, turning up to work each morning to find out whether or not his employers wanted him that day; parents worrying whether their children would ever be able to afford their own homes; and family after family living in overcrowded and sub-standard housing and no hope of moving on. While the economists' statistics were showing growth, ordinary people were feeling less financially secure, they were in increasing debt and most importantly they were struggling to see this changing anytime soon.

Unsurprisingly perhaps, I lost that election and went back to my regular job as an adviser to one of the Chief Scientists in the UK Government, where I worked as part of a team tasked with improving the use of evidence in government policymaking. I saw for myself how carefully evidence is gathered, checked and challenged before being used in policymaking. Yet time and time again, we came up against instances where public campaign groups rejected this evidence. While my colleagues put this down to campaign tactics, or people being irrational, the stories the voters had told me kept coming back to me. I just couldn't shake off the growing sense that we - as experts, scientists, policymakers and politicians – were missing something really important that was happening out there.

To start understanding more about this gap between expert and public perceptions, I decided to look at the ways in which 'experts', politicians and the public discussed key issues. My thesis was that if people were experiencing the world differently, then these differences would be evident in public discourses and documents. Having been involved in scientific expert decision making, it made sense to start looking there. So I gathered 15 years' worth of scientific reports, policy documents and records of public debates relating to new and emerging science and technology, and set about identifying the ways in which science and technology, and their place in the world was discussed in each set of documents.

The first thing I found was that there was indeed a difference between the way that 'experts' (scientific reports) and the public (records of public debates) talked about science and technology (Smallman 2018). However, the way the policymakers (in government reports) talked about science and technology was almost identical to the way that the scientific experts were talking (besides the obvious changes in technical terminology). This pointed to what I described as an elite perspective or imaginary of science and technology, that I called "Science to the Rescue". Specifically, the science to the rescue imaginary, found throughout the policy and scientific reports, treated science and technology as one of the key (if not the only) solvers of problems in the 21st and as a driver of economic growth. The benefits of technological innovations were seen as inevitable, to such an extent that they were rarely discussed or specified. Any possibility of social and ethical issues of concern arising from these scientific or technological developments were considered to stand aside from the science or technology itself and to be public concerns and matters of risk and understanding that can be quantified, managed and turned around with more research and more information (Smallman 2018).

This story of 'science to the rescue' is probably very familiar. You will see it in any policy document about science and technology. Whether it is a scientific academy introducing their latest strategy, the British Prime Minister explaining how he will rebuild the economy in the wake of the UK leaving the European Union, or the European Union describing the Horizon Europe stream of funding, the idea that science and technology is a driver of the economy, producing growth and wealth for the country and solving the most pressing

problems facing modern society, as well as the sense that any downsides can be managed and separated, is omni-present.

This idea of science as a solver of problems, bringing benefits (economic or otherwise) to everyone also appears to cross cultures and time. For example, each year I present the following quote to students on my science policy course and ask them who said it:

"We must show … that the organization of industry on the basis of modern, advanced technology…will make it possible to raise the level of culture in the countryside and to overcome, even in the most remote corners of the land, backwardness, ignorance, poverty, disease, and barbarism."

Without fail the quote gets attributed to a recent politician – George Osbourne, Gordon Brown, Margaret Thatcher and even once recently Mark Zuckerberg. Yet it is actually taken from a speech given by VI Lenin in 1920 to the All-Russian Central Executive Committee of the Congress of Soviets of Workers', Soldiers', and Peasants' Deputies. The relationship between communism and science went on to take a well-documented and disastrous turn (Agar 2013, P199), yet this early vision of the place of science and technology in the communist world is strikingly similar to the way in which modern, western politicians and scientific leaders talk about science and technology today – and have throughout the 20th Century. It is also strikingly similar to the ways in which low and middle income countries are coming to think about their own paths to economic growth too. For instance, as I will describe more fully later, Science and Innovation has been seen as a key way in which South Africa can redress the in-built inequalities of the past, making the country more competitive in a global market place, providing benefits to the poor and making South Africa a fairer place (Smallman and Beumer 2022).

Perhaps it isn't surprising for scientific bodies to talk up the benefits of science, nor perhaps for governments to be committed to what has been a very effective engine of economic growth throughout the late 20th Century. However, it does become surprising when considered alongside the way in which the public talked about science and technology in their debates. While the public agreed that science and technology produced goods and

solutions, they were also clear that problems were produced too. Most importantly, they saw the benefits and downsides to be inextricably bound to the technologies themselves, such that one couldn't exist without the others. In their minds, it was impossible to have just the benefits of the technologies and to minimise or manage the downsides. They were opposite sides of the same coin. While the elite groups sought to solve any problems caused by science and technology, the public discussions focused on balancing out the strengths and weaknesses of the technologies, asking "are the benefits sufficient for us to be able to accept the downsides?", rather than "how can we minimise the risks?'. Importantly, instead of these public perspectives being irrational, and oppositional views which can be brought around with more education and information, the public perspectives I found in these documents were acts of deliberation, as if people were flipping the coin about to see which side it was loaded to land (Smallman 2018).

The differences between these two perspectives are perhaps small, but are really import if we think about the effect that science and technology is having on our lives. Elsewhere (Smallman 2019a) I have made an analogy between advanced technologies and cars: If we think like the experts with the science to the rescue imaginary in our minds, then you could claim that cars have been a valuable if not transformative way of getting from A to B. Downsides such as emissions can be solved by technology – more efficient or alternative fuel engines. However, as an account of the impact of cars on human lives in the 20th Century, this is an incredibly limited analysis. Looking out of our windows, we can probably see how cars have shaped the very fabric of the towns and cities we live in; and they have also affected our social lives too, impacting on decisions like where we work, who we are friends with, how often we visit our families. Importantly, these choices and the roads infrastructure that has been put in place since the advent of the car are as much the products of cars as is improved transport. In other words, cars effect more than just those driving - it has had profound effects on the shape of everybody's lives, structuring cities and lives in very particular ways. And the benefits and downsides are inextricably linked to the car itself. This is how the public in my studies were thinking about new technologies.

These differences in how the relationship between technologies and their impacts is perceived and accounted for, in my view, underpins many of the wider more troubling

differences in perspective amongst different groups in post-industrial nations today. Perhaps this sounds an extreme position to take when talking about science and technology. But this is exactly the problem – the idea that science and innovation drive economies, solves problems and brings benefits to everyone has blinded us (and scientists and policymakers specifically) to the full impact of technological change on people's lives – the way that technologies are being encountered and experienced differently by different communities, the loss of control many are feeling as particular paths to the future are being carved out and closed off by these new technologies and people's anxieties about the shape of these paths they are being directed down. The imaginary of Science to the Rescue has also distorted the voices of people expressing their concerns about these directions of travel, such that we have heard alarm bells heralding in the end of reason when we should have been listening to the signals that could have directed up onto a better, more equitable, path to the future. As a result, governments have failed to take the action necessary to ensure that advanced technologies are not driving further inequality. Instead, the science to the rescue imaginary has been embedded deeper and deeper inside the machinery of policymaking, making it almost impossible for public concerns about the social and ethical issues raised by technologies – particularly in relation to the direction of travel they are taking us – to be heard. This, I argue is leading to a situation where ordinary citizens feel powerless and unserved, while experts holding this imaginary misunderstand these views as oppositional and misdirect public concerns as being matters of education, rather than matters of democracy.

When science does not come to our rescue

Going against the grain of the dominant 'science to the rescue' imaginary of science and innovation as a driver of economic growth and shared wealth, over the past ten or more years, scholars of economics, innovation and of science and technology studies have been building up a picture of how technology – and digital technologies in particular – is actually driving inequality. Innovation scholar Susan Cozzens went as far as to describe technological change as one of the most significant forces driving global inequalities (Cozzens 2008). So what has led to this surprising conclusion?

Firstly, there is a question of whose problems does science and innovation solve, as well as who has access to the solutions being offered? Heeks, Foster, and Nugroho (2014) argue that 'mainstream innovation' has targeted middle- and high-income consumers with products that improve their productivity and wellbeing at the expense of problems faced by poorer consumers, or those which are based on social development rather than economic needs. The classic exemplification of this is what has become known as the 10/90 problem – the mismatch between the priorities of the pharmaceutical industry and the challenges of global health which led to the Commission on Health Research reporting in 1990 that less than 10% of worldwide resources has been put to tackling the infectious diseases that were causing 90% of preventable deaths globally (Commission on Health Research for Development 1990). While non-profit organisations such as the Gates Foundation and the Wellcome Trust have refocused some resources to these historically 'neglected' diseases, making steps to rebalance investment in the intervening years, the idea that science has helped us live healthier and longer lives simply does not apply to the majority of the world's population.

Secondly, for some groups, science and technology have made, and increasingly appear to be making, their lives worse, as the risks or downsides of advanced technologies reinforce and exacerbate existing inequalities. Typically, those who were historically most disadvantaged are being further disadvantaged by new technologies like AI and automation. The arguments about "biased data in - biased results out" are well trodden, but our understanding of the reinforcing effects of data driven technologies goes well beyond that: The punitive effects of many of these technologies often spring from pre-existing ideas of who matters, who should be visible and who should not, and how the world should be arranged around this – ideas that get embedded into the technologies as they are developed. For example, Ruha Benjamin (2019) has described how the commonly held idea that automated systems are inherently objective (or at least more objective than what has come before) and therefore able to perform tasks more fairly than humans is not just making these technologies particularly prone to discriminatory outcomes, but is also hiding those discriminatory effects from view, creating a form of coded inequity. To make that concrete, I was recently asked to advise a project within the EU seeking to develop a predictive policing algorithm. There were many things troubling with the project, but one of

the more absurd features was that deep inside the predictive algorithm was the criteria "presence or absence of facial hair?" It is possible to imagine that a high score from an algorithm based on a series of criteria such as this could be sufficient for authorities to justify restricting someone's civil liberties (subjecting them to stop and search, for instance), yet you don't have to look hard to see the very sinister racial prejudices buried right at its heart. Similarly, Virgina Eubanks (Eubanks 2007) has described how low-income households in the US often only interact with online services – typically through public libraries and support centres - when they need to apply for state benefits. Since this process is most usually frustrating, unfulfilling and results in access to benefits being denied, for these low incoming families the online world is not seen as the same world of possibility, access and convenience that more middle-class households would experience. Indeed in many instances, it is the technology itself that is creating the sense of disenfranchisement or disempowerment: I recently saw this for myself at my local supermarket, when an older woman who I have regularly seen shopping happily alone was being helped to use the newly installed self-service machines while all the regular checkouts were closed. Without any change to her medical condition, by being forced to interact with a device that the shop had decided was labour-saving for them, the woman had been rendered helpless, dependent and elderly.

Perhaps the biggest challenge to mainstream thinking about how science comes to our rescue however, is the insight that technology economists have offered on the role of advanced technologies in driving economic growth. Specifically, how digital technologies have broken the link between GDP and average wages, polarising wealth and increasing inequality within high-income countries as a result. In their 2014 book "The New Machine Age", MIT economists Erik Brynjolfsson and Andrew McAfee describe the mechanism for this with a comparison between the 'old' photography company Kodak and the new digital-era equivalent Instagram/Facebook. While Kodak made its founder George Eastman very rich, it also provided well paid jobs for generations. At its peak, Kodak employed 145,300 people directly and thousands more through its supply chain. In contrast, Facebook has created at least seven billionaires, each with a net-worth ten times greater than George Eastman, yet when Facebook bought Instagram for $1 billion in 2012, Instagram had just 15 employees (Brynjolfsson and McAfee 2014 P126) . The important point they make is that

this couldn't have happened with previous technologies – there is something new about digital technologies that is driving the polarisation of wealth at a rate that we haven't seen before. They put this down to three key features of digital technology (the 'triple threat'): 1. The way they enable goods to be produced and distributed at scale without an equivalent scaling of workforce; 2. The way that in the digital world a relative advantage allows companies to secure total domination of their sectors (does anyone remember Lycos or Excite search engines anymore?), creating a winner takes it all market, since capacity is irrelevant with digital goods; 3. The way that digital technologies allow goods to be produced anywhere in the world, enabling companies to move operations to favourable tax regimes and creating the phenomenon of stateless profits (Brynjolfsson and McAfee 2014 P126-146). Echoing this last point, the European Commission (Hadzhieva 2016) described how the aggressive tax avoidance strategies of big digital technology companies are contributing to the €1000bn tax revenues lost in the EU annually, similarly attributing this recurrence of tax avoidance in the digital sector to its "unparalleled reliance" on intangible assets such as personal data and the technologies' ability to make it very difficult to determine where value creation takes place. Bruce, Fox, and Luna (2009) estimated that thanks to these qualities, e-commerce would cause national state and local sales tax losses in the US alone to rise to $11.4bn a year by 2012. Ironically, the technologies that many policymakers see as delivering more cost-effective public services in the future – propelled by this belief that science and technology will come to our rescue - could be the very forces that make public services unaffordable in the future.

Economists are also showing how advanced technologies are having a profound effect on the job market, with a tendency to create higher demand and wages amongst male, high-skill, hi-tech workers, raising wages at the higher end of the job market and often automating and eliminating jobs at the lower end of the wage scale (Cozzens, Bobb, and Bortagaray 2002; Acemoglu and Autor 2010). Cozzens et al (2002) have pointed out that, importantly, this shift is also driving insecurity in lower paid jobs across the board. The jobs that digital technologies have eliminated tended to be in industries like manufacturing, where low-skill worker were relatively well paid and secure, since these industries were well organised to protect workers' rights. In eliminating these jobs, the digital sector has served

to undermine the trades union movement more widely, effecting jobs elsewhere in the long term.

Brynjolfsson and McAfee (2014) conclude that while innovations like digital technologies are growing the size of the economy overall, they are also polarising wealth to such an extent that "some people, even a majority of them can be made worse off by advances in technology." (Brynjolfsson and McAfee 2014 p173)

Looking at the economy, and the place of digital technologies within it in this way, it possible to see how the difference of understanding between politicians and the citizens I met on the doorstep – or indeed between experts and the voters in the European Referendum – had arisen. While the politicians and economists were describing the economy as booming, based on their measures of how the economy and GDP had grown, the voters I met on the doorstep – and many of those voting to upset the status quo and leave the EU in 2016 - were the majority who were getting progressively worse off from this new hollowed out, polarised economy. Overlaid upon that, as I will discuss more later, the dominant 'science to the rescue' imaginary has been making it difficult for politicians to see these harmful effects and to take the actions necessary to address them.

This account of the impact of technologies on ordinary people's lives – how the benefits of science and technology are patterning in particular ways that are tending to reinforce existing inequalities - is not just limited to academic debates though. While I would argue that while they have misdirected the root of this problem onto immigrants, Europe etc. the same sense of ordinary people not getting their fair share, or change working to their disadvantage, underscores most current populist discourses. Such a sense is also becoming evident in public opinion too, particularly in surveys of public attitudes to science and technology. For instance, in 2018, the Wellcome Trust carried out the biggest study of public attitudes to science to date. Their 'Global Monitor Survey' looked at how people around the world think and feel about science and major health challenges and surveyed 140,000 people in more than 140 countries. The headline figures were very positive, with 72% of people globally saying they trust scientists and 70% saying they felt that science benefits them. However, only around 40% of people believed that science benefits most

people in their country and approximately one third of those surveyed in North Africa, Southern Africa, Central and South America said they felt personally excluded from the benefits of science. In high-income countries, attitudes appeared to be linked to income levels, with people who said they were 'finding it difficult' to get by on their present income being about three times more likely to be sceptical about the claim that science benefits them personally, compared to those people who said they were living comfortably. Overall, the Wellcome Trust Global Monitor (2018) found that all things being equal, those who feel most comfortable on their present income (arguably those benefitting from technological change) are most likely to trust science and that more economically unequal societies tend to have lower levels of trust in science. The most recent Eurobarometer survey of European citizens, carried out in April 2021 (European Commission 2021), found similar. On the one hand, participants expressed broadly positive views of science, with 86% of EU citizens agreeing that the overall influence of science and technology is positive. Nevertheless, 25% agreed that science and technology do not really benefit people like them. The majority of respondents in every EU27 country agreed that while science and technology could improve everyone's lives, it was mostly going to improve the lives of people who are already better off. These findings seem to chime very closely with the account that my neighbours on the doorstep back in 2005 were giving – that life was getting better for some people but not for them – as well as the account given by my colleagues in science and technology studies – that scientific and technological developments were at the heart of this.

How have governments dealt with the power of technology to drive inequality?

Given how significant – and arguably well-documented – the effects of technological developments are on growing inequality, and the focus of many governments on reducing inequality, presumably these problems have been accounted for in innovation policy?

This is a question that my colleague Koen Beumer and I have been asking for the past few years. More precisely, given that innovation is widely seen as the engine for growth in most economies, we have been asking whether any concerns about the possibility for digital technologies to grow inequalities have been taken into account in innovation policies. Put simply, when it comes to innovation policy, is the size of economic growth the only thing that matters or do policymakers care about the spread of economic growth too?

To answer this, we chose to compare approaches in two countries that we were both familiar with, which both had strong policies to support technological innovation, but which each had very different levels and histories of inequality – the UK (which had G20 average levels of inequality) and the Republic of South Africa (which had the highest level of inequality in the G20). It seemed reasonable to suppose that if there are varying approaches to supporting innovation and tackling innovation-driven inequality, then we might find them by comparing the innovation policy documents these two countries.

What we found (Smallman and Beumer 2022) was that the two countries did indeed have very different takes on the relationship between inequality and innovation. In the UK issues relating to inequality relating to innovation were seen as a regional development and workforce supply issues. It was important to increase regional innovation and get more women into science jobs, in order to ensure all parts of the country and population were economically productive. Any sense that the risks and benefits of technological innovation are shared unequally (beyond access to jobs and regional productivity), or that the needs of some groups were being unmet or exacerbated by such developments, was absent.

In South Africa, the story was slightly more complex but with similar absences nevertheless. Overall, addressing economic inequality was one of the main justifications for pursuing science and innovation in the South African policies we looked at. As such, they explicitly focused on making the South African innovation system responsive to the needs of economically and socially disadvantaged groups – creating a national system of innovation that would allow more government control to ensure that previously disadvantaged people and places were included, with significant parts of the budget specifically reserved for innovations that specifically target the poor.

In common with the UK however, we could find little evidence of policies to tackle the economic consequences of technological innovation and their potential to polarise wealth. In both countries, the only model of ownership considered by innovation policy was the privately owned company. The absence of any attempts to encourage alternative models that would better share assets and gains with workers, states or communities was coupled

with no significant activity around fiscal policy or taxation focused on redistribution. This, we argued, was underpinned by the assumption that the economic growth that comes from innovation policy will eventually benefit everyone – which I now argue is the familiar idea of 'science to the rescue'.

Developing this argument further, it seems that the 'science to the rescue' imaginary is having an important effect on innovation policy – encouraging countries around the world to invest in advanced technologies with the expectation that this will drive growth, perhaps in the same way older technologies did in the 20th Century. However, without understanding the downsides (specifically the potential to polarise wealth) that are inextricably linked to advanced digital technologies, there is an absence of the policies that should be acting as the safety rails to ensure innovation driven growth is fair, equitable and not exacerbating the very problems they set out to tackle.

To address some of these oversights, a number of colleagues have been arguing for more inclusive and participatory approaches to innovation and technology development, such that wider voices are heard within the policymaking and development process (Cozzens 2007; Jasanoff 2003; Wynne 1993; Owen, Macnaghten, and Stilgoe 2012). In the UK, this approach has been adopted through both the ScienceWise programme, which offers central government policymakers the opportunity to engage members of the public in discussion of new and emerging technologies before policy is made, in order to better reflect their views; and through the Responsible Research and Innovation (RRI) agenda, which contains a similar commitment to enabling wider voices to be heard in the innovation process (Smallman, Lock, and Miller 2020). Originated and originally adopted by the EU Horizon 2020 programme, RRI has since been embedded in the UK Research Councils' funding and training programme.

However, unfortunately, there is little evidence that these participatory approaches make any impact on policymaking (Smallman 2016; Stirling 2007; Hansen and Allansdottir 2011). And the 'science to the rescue' imaginary – especially the idea that the social, economic and ethical effects can be separated from the technology and managed – is partly to explain why policymakers haven't been able to take account of public perspectives in these contexts.

As I described earlier in this article, I have looked at 15 years' worth of public debates relating to new and emerging science in the UK, along with the parallel policy reports on the same topics. The majority of these public debates were the outcomes of the participatory exercises advocated for by my colleagues. My finding that the public and 'experts' had very different ways of talking about and therefore thinking about science, technology and their relationship with society suggests that those public discussions had little impact on the policy perspectives, in the sense that the overarching viewpoint of the public (that science and technology produced goods and solutions but also problems, and that both the benefits and downsides were inextricably bound to the technologies themselves) was not reflected in the policy documents. Instead, public perspectives were described as lists of concerns that needed more research and expert input to resolve (Smallman 2018).

Others have argued that this failure to take public perspectives into account is the result of technoscientific perspectives and 'cultures' within policy-making institutions (Macnaghten and Chilvers 2014) or imbalances of power (Welsh and Wynne 2013; Bora 2009). However, following a series of interviews with policymakers, I found that it is the 'science to the rescue' imaginary of science – or more precisely the way that policymaking structures, laws and institutions have been built by those holding that imaginary – that is preventing public perspectives being heard and acted upon (Smallman 2019b). And it appears to work in three ways.

Firstly, the 'science to the rescue' imaginary influences the way science can be discussed and how public perspectives may be expressed in public dialogue events, with discussions typically framed by the potential (real or imagined) of the science at hand to solve extreme problems – like cancer or climate change. As a result, discussions about potential uses are transformed into discussions of conditions for use, with very little room left for any concerns to have status beyond that. Compounding that, in my interviews, policymakers expressed concerns that there was a tendency for the public to allow values-based concerns to creep into discussions about technical matters, for example, raising concerns about the mechanisation of farming in discussions of GM foods. Again this echoed the 'science to the rescue' view that science and social and ethical issues are separate matters. In this way,

subtle public perspectives are turned into simple confusions that can be either turned around or discarded.

Secondly, the policymakers I interviewed described how the machinery of policymaking itself has been shaped around the 'science to the rescue' imaginary in a way that prevents policymakers from taking nuanced public perspectives into account. Policymakers described instances where they understood that the public were giving complex accounts of the relationship between science, technology and society, but nevertheless were unable to draw upon this complexity within policymaking. Specifically, schemes of delegation and required standards of evidence have been arranged in a way that splits technical matters from 'other' aspects of the issues. For instance, policymakers pointed me towards the European regulations regarding GM foods, which in their view offered no space for non-scientific matters to be considered, as the 'rules of procedure' stipulate that the focus of evidence submissions within the decision-making process must be based upon scientific review, rather than any wider issues of risk or policy impact, which are dealt with elsewhere. In order to account for social and ethical concerns in this system the interviewees described how they felt they had no other option but to express these concerns by challenging the science. This was put very well by a UK policymaker:

"the science becomes so dominant in the decision-making process around GM, that people are challenging the science, partly because they have other issues they want to express and there is no forum for them for doing that."
Civil Servant (from Smallman 2019b)

Almost regardless of the mechanism though, the really important point is that repeated attempts to bring public perspectives into policymaking have failed. But rather than public perspectives being ignored or out-competed by other evidence or priorities, they are simply distorted or discarded by a machinery of government which is shaped around the 'science to the rescue' imaginary, making it impossible for policymakers to accommodate nuanced public understandings that see risks and downsides as inherent properties of new technologies.

Jasanoff and Simmet (Jasanoff and Simmet 2017) have made a similar point in the context of the 'post truth' moment in the US, arguing that in areas like climate change policy, the focus on scientific evidence has forced value concerns to be played out via technical debates. And although we know that values and judgements are deeply embedded in scientific 'factmaking', this reliance on seemingly technical or objective facts alleviates policymaker of the need to give moral justification to their decision-making. Nevertheless, important debates about values, lived experiences and the kind of future to which people aspire, become hidden in technical discussions and decisions. Public challenges to scientific evidence – perhaps of the kind that gives rise to the concern that science is under stress – arise as replacements for the real debates that have been pushed outside ordinary people's reach, but which are so desperately needed.

With the advent of AI and automation technologies, ethics appears to have taken over from more participatory approaches as a way of accounting for concerns about these new technologies as, over the past 5 or more years, we have seen a rash of new ethical frameworks. Surprisingly perhaps given the potential of digital technologies to drive inequalities and for algorithms to raise or occlude important questions about democracy and the shape of the world, these guidelines have clustered around five (rather modest) ethical principles of transparency; justice and fairness; non-maleficence; responsibility & accountability; and privacy (Smallman In press). Moreover, the motivation of these ethical frameworks is, without exception, to enable these technologies. It is not that it is inconceivable within this context for an effect to be too detrimental to be permissible, or for a vision of the future enabled by these techs to be too abhorrent to continue, but that the downsides of these technologies are seen as very modest side effects or glitches that can be designed out or managed (Smallman In press). Yet again, science and technology is being seen as coming to our rescue and as a result important measures to protect us from the worse effects of these technologies are overlooked.

Perhaps this brings us to the troubling conclusion that we have found ourselves in a very difficult bind, whereby the tools (scientific and technological innovation) that we passionately believe can be the solutions to many of the economic and social problems facing many nations in the early 21st Century (low productivity, stagnating wages, growing

inequality and unaffordable demands on public services, for instance) are actually the forces driving these very problems deeper into our lives and economies. And whereby our belief in the power of science to come to our rescue is actually stopping us from seeing – or acting to limit these paradoxical effects. Perhaps the people I met on the doorstep in 2005 - and those who have been voting for populist parties since - are right and there is nothing left to do but agree with them that things are not getting better and we have indeed heard enough from the experts who claim otherwise. But that has not been the purpose of my argument. Because despite the counter story I have given here of how we are misguided in our assumption that science will automatically come to our rescue, my aim in challenging the dominant account of the role of science and technology in our lives is to move us further towards the possibility that science and technology can fulfil that role and come to the rescue of more and more of us. Regardless of how things are playing out at the moment, science, technology and innovation undoubtedly have the potential to live up to their reputations of being the most powerful tools we have to improve the lives of people on our planet. It is just that it won't happen if we don't pay attention to all of the potentials that they bring – the harms, the social shaping effects, as well as the possibility to solve our problems.

So what can we do? How do we adopt a more sophisticated and nuanced account of how science and technology effects our lives, that reflects the inequalities that they are driving as well as the problems they can solve, in a way that enable more democratic and less authoritarian societies to flourish? Looking hard at the implications of advanced technologies on wages and the affordability of public services, the effect of automation on job markets and workers' rights, and the potential of data storage and surveillance technologies to advance us blindly towards more authoritarianism – all of which appears to have been accelerated by the COVID-19 pandemic - I don't think I am exaggerating in saying that this is one of the most important questions of our age. As such, it won't be answered simply, or by me alone. But the first step will be to hear and understand what people are telling us about their experiences of the worlds we are creating with science and technology. We need to ask questions about the kinds of infrastructure, regimes and social arrangements that new technologies lend us towards and consider whether these are indeed the kinds of social arrangements that allow societies to thrive in the future, or

whether we need to take a different approach to developing and regulating technologies. Most importantly, rather than worrying that people are irrational and have heard enough from the experts, we urgently need to embrace the other populist slogan and allow people to "take back control" of their futures.

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