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SCIENCE INTO TECHNOLOGY

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Another Grim Day for Big Science…

Science pervades our lives at every level, supposedly guiding public policy in almost every area, and thanks to the internet increasingly affecting our behaviour directly. Its easy to assume that this rational approach does nothing but good. But fashion affects scientific thinking as much as every other human endeavour, and even the what seems to be irrefutable logic can lead to poor decision making when applied to complex human behaviours.

Nowhere is this more obvious than in public health. For millennia, until the middle of the 20th Century, people generally assumed that their lifespan was pretty much set by factors outside their control, and while avoiding certain high risk activities (such as fighting in wars) might be a wise move from a longevity perspective, there was little else to be done than accept your allotted span on this mortal coil.

Pioneering work in the 1960s led by Sir Richard Doll changed all that. With their discovery that smoking tobacco increased your risk of cancers and heart attacks, they signaled to the public that even relatively minor lifestyle choices can contribute to their eventual demise. Over the subsequent decades, the advice on what constitutes a healthy lifestyle grew from a trickle to a torrent. By the turn of the millennium, with the internet speeding dissemination of information, the average Westerner was left in a state of shock by the constant bombardment of advice on how to live healthier for longer. For an increasing number, their response has been disengagement – with no means to distinguish the rational from the quackery, the only logical response was to ignore the whole constellation of health advice.

"Until the 20th Century people generally assumed their lifespan was set by factors outside of their control"

Its easy to discount this reaction as being due to lack of education. Faced with information overload and a lack of scientific expertise, the non-expert is bound to find it difficult to make rational decisions – even if the advice is all scientifically sound.

But what if our reliance on science has simply extended way beyond the ability of the scientific method to deliver? Could we even be suffering from the delusions of the emporer's new clothes (where those that 'understand' science continue to believe in its powers even as it becomes obvious to everyone else that it's utility has been dramatically overstated)?

Unfortunately, the evidence is starting to grow that the man in the street may not be far off the mark. Some of the high profile failures of science are easy enough to explain away: the MMR and autism

debacle wasn't so much a failure of science but a consequence of the modern media frenzy for "interesting" stories. The opinions of a few mavericks were given as much credibility as the weight of counter-evidence supported by the establishment. When a radio show wants to discuss such an issue, for instance, they get one "expert" from each side of the argument to put their case, creating the illusion of balanced support among the scientific community, even if in reality 99 experts support one view for every single supporter of the countervailing position.

However, cracks are also beginning to appear in the "official" position. A report in the April 6th edition of the *Journal of the National Cancer Institute* drove another nail into the coffin of scientific credibility. The subject matter? Fruit and vegetables. Since 1990, bodies as well respected as the World Health Organization and, in the UK, the Department of Health have recommended everyone eat five portions of fruit and vegetables a day. Resources have been invested in advertising campaigns and the message has reached the public consciousness (almost everyone knows they *should* be eating more fruit and vegetables, even if the lasting impact on people's diets has been somewhat less impressive than had been hoped for).

The evidence for this public health campaign (which has been one of the central planks of the UK governments drive for improvements in public health) seemed sound enough: summarising a lot of work in just a few words, the bottom line is that people who ate more fruit and vegetables were at lower risk of major cancers and of heart attacks than those who ate little or no veggies. Leading nutritionalists had dared to speculate that these five portions of greenery a day could cut cancer rates in Western countries by 50%!

Twenty years after this health advice went international, the first large scale study of the impact of increasing fruit and vegetable content in the diet was reported in the respected Journal of the National Cancer Institute. The conclusion? Eating more veggies resulted in a maximum benefit of a paltry 2.6% reduction in cancer rates – and the authors couldn't even be sure if this marginal benefit was real and robust.

So the public policy engine threw its considerable weight behind this campaign expecting a 50% reduction in major cancers – and the actual benefit is, at best, 2.6%. What can possibly be the origin of this 20-fold discrepancy? Surely one of the studies must be wrong?

"The only figures you can trust to guide your behaviour come from interventional studies – time after time cross-sectional studies over-emphasise the benefit of a particular factor"

Not at all. Both figures are true. But only one of the studies actually tested the real hypothesis. The first studies (the ones which saw the big benefits) were all cross-sectional in design – that means they divided people into groups based on how much fruit and vegetables they ate, and then looked at their risk of developing cancer. The "healthy eaters" had a much lower risk. The newer studies (with the negligible benefit) looked at *changes* in diet or corrected for other confounding factors. In other words, taking the people who ate little fruit and vegetables and getting them to eat more has, by itself, very little benefit. The reason for the large discrepancy is presumably that those who were already eating fruit and vegetables were also more likely, on average, to be doing other healthy things (exercising more, maintaining a healthy bodyweight, reducing alcohol consumption, stopping smoking, visiting their doctor more often for blood pressure checks, taking vitamin supplements or whatever).

All of these health behaviours *in aggregate* are associated with improved health, but the contribution of eating more fruit and vegetables alone is, it now transpires, very small indeed.

Remember, though, that the only figure you care about is the figure from the intervention study. Can I make myself healthier by changing my lifestyle in a particular way? The answer, at least for fruit and vegetables and cancer risk, is 'not really' in any meaningful sense.

This time it wasn't a few maverick scientists on a crusade about MMR vaccination that got it wrong. It was the World Health Organization. And the UK Department of Health.

If this latest chapter were an isolated incident, we could call it unlucky. But exactly the same scenario played out with the fat content of our diets. Cross-sectional studies said that people who ate diets high in fat were at greater risk of heart disease and cancer. But an eight-year interventional study in almost 10,000 Americans showed that substantially reducing saturated fat intake had no impact on longevity, or indeed any measurable effect on specific diseases such as cancer or heart attacks.

"Bad advice leads to disengagement, distrust and disappointment. Scientists and policymakers must do better"

Nor are such examples of over-interpreting the available data limited to healthcare. The current furore around climate science suggests that exactly the same phenomenon is going on there – what has been observed is not in doubt, but what it actually *means* is still a live debate. Using science to guide major public policy decisions is considerably harder than it seems at first glance.

All of this is not to say that science isn't useful, and hasn't delivered tremendous benefits to society, any more than it is to say that it isn't worth trying to live a healthy lifestyle. But it is a cautionary tale about the over-reliance many of us, and more particularly those of us with 'technophile' tendencies, can place on science. Even mainstream scientific opinion, backed by leading institutions with the highest credibility, is increasingly getting it wrong on the big issues.

Perhaps in choosing to ignore the rising level of science-based opinion and chatter, using the vast array of conflicting opinions as a surrogate marker for a lack of certainty, the man on the street has got the balance about right. When it comes to applying science to the really big issues of the day, more care is needed by everyone involved to make sure the evidence really does address the question of interest. Too much extrapolation, as the fruit and vegetable saga shows, leads to bad advice – and bad advice, in the end, leads to disengagement, distrust and disappointment. Scientists and policymakers must do better.