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The Scientific Evidence That Artificial Intelligence (AI) Will Continue to Fail, Until We Deploy 'Intent'

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Electronic machines in the guise of digital computers have transformed our world—social, family, commerce, and politics—although not yet health. Each iteration spawns expectations of yet more astonishing wonders. We wait for the next unbelievable invention to fall into our lap, possibly without limit. How realistic is this? What are the limits, and have we now reached them? A recent survey in *The Economist* suggests that we have. It describes cycles of misery, where inflated expectations are inevitably followed, a few years later, by disillusion. Yet another Artificial Intelligence (AI) winter is coming—"*After years of hype, many people feel AI has failed to deliver*". The current paper not only explains why this was bound to happen, but offers a clear and simple pathway as to how to avoid it happening again. Costly investments in time and effort can only show solid, reliable benefits when full weight is given to the fundamental binary nature of the digital machine, and to the equally unique human faculty of 'intent'. 'Intent' is not easy to define; it suffers acutely from verbal fuzziness—a point made extensively in two earlier papers: *"The scientific evidence that 'intent' is vital for healthcare"* and *"Why Quakerism is more scientific than Einstein"*. This paper argues that by putting 'intent' centre stage, first healthcare, and then democracy can be rescued. Suppose every medical consultation were supported by realistic data usage? What if, using only your existing smartphone, your entire medical history were scanned, and instantly compared, within microseconds, with up-to-the-minute information on contraindications and efficacy, from around the globe, for the actual drug you were about to receive, *before* you actually received it? This is real-time retrieval of clinical data—it increases the security of both doctor and patient, in a way that is otherwise unachievable. My 1980 Ph.D. thesis extolled the merits of digitising the medical record—and, just as digitisation has changed our use of audio and video beyond recognition, so a data-rich medical consultation is unprecedented—prepare to be surprised. This paper has four sections: (1) where binaries help; (2) where binaries ensure extinction; (3) computers in healthcare and civilisation; and (4) data-rich doctoring. Health is vital for economic success, as the current pandemic demonstrates, inescapably. Politics, too, is routinely corrupted—unless we rectify both, failures in AI will be the least of our troubles.

Keywords: Artificial Intelligence (AI), 'intent', digitising the medical record, data-rich healthcare, real-time retrieval of clinical data

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Where Binaries Help

Einstein liked computers. That is because these over-grown calculating machines excel at mathematics, as he did. They are not so hot when dividing by three, nor with approximations as to π (Pi)—though even here, they cope well enough by adding as many decimal places as you could possibly wish for. But Einstein, colossus though he was, could not get his head around Quantum Mechanics—it was the unruly nature of electrons that left him unconvinced. He treasured the apparent Certainty, the seemingly endless predictability of mathematical symbols—so when the Uncertainty Principle stated that you could never be Certain where an electron was—or if you knew that, where it was going next, he was flummoxed. This objective scientific finding undid his cherished notion that we could reliably understand physical reality—the Uncertainty Principle put paid to that, since there is an inbuilt Uncertainty in the very heart of everything we can possibly know, which no amount of mathematical predictability can remedy. This physical finding, this lump of scientific physics, quite dislocated his conception of the world around him, as it has many others, both before and since. Exceptional ability at calculating can no longer guarantee realistic success in this imperfect world, either for Einstein, or for computers. We have to look elsewhere, and soon.

Now computers can do amazing things, with vastly more still to come, especially in healthcare. In doing so, they become quite complex. So, it is important, at the outset, that we grasp just how simple they all are, at heart. Every single computer that ever was, or ever will be, runs on "0's" and "1's"—01101010101—this is the basic language of any and all computers. This is binary—it has two "letters", and only two. If they handled anything else, then they would not be known as digital computers. They would be something else. And they would be so slow as to be tedious.

You do not even have to look inside a computer to see this—just look at the next bar code, or QR-code, that comes your way. Lines of black and white—thicker lines are "1's", thinner lines are "0's". In the case of the little square QR-codes, the white squares are "0's" and the black ones are "1's" (even to look at, it is tiring).

How do I know this? Well, that is why computers are so successful—if it were not for this stark simplicity at their very core, they could not even begin to do what they do. You and I have to deal with 26 letters in the Roman alphabet, and that is one of the simpler ones. If a computer had anything like that number, even as many as three, then it would long since have ground to a halt. No, it is being strictly, always and forever, binary that has kept the computer going. Binary is what the computer is and does—like it or lump it.

If that seems far too simple for such modern wonders, there is something else about them that is even more extraordinary. Just as "0's" and "1's" are its bread and butter—never anything else whatsoever—what are the only two things it ever does with them? Well for this, we have to go back to the 1930s, to Alan Turing, the unsung (and abused) computer genius. Back then, and as if out of the blue, he made his astonishing prediction—any machine that could do two simple mathematical procedures could cope with all the complexities that any mathematics could ever throw at it. The profundity of this conception is difficult to grasp. Perhaps when his name appears on the forthcoming UK's plastic £50 note, his true achievements might be more widely appreciated.

What are these two particles of mathematics? Subtraction and multiplying by 10—something we all learn at primary school. Technically, subtraction is quite difficult to conceptualise, and multiplying by 10 goes by its proper name "left-shift" (so as to accommodate number bases other than 10)—but either way, the essence could not be simpler: multiplication and subtraction. Who could possibly imagine that all the electronic wonders of the modern age, from smartphones to streaming videos—all rely, firstly on the stark simplicity of the binary digit, and then on ridiculously elementary subtraction and multiplication?

Of course, astonishing amounts of desperately hard human labour have gone into the final computerised outcomes, which we increasingly take for granted. But as with anything complicated, it pays massive dividends to start with the basics, and move on from there, once they are firmly established. And since there may be some readers who baulk at this simplification—for them, I would only say—if Turing was right to make his astonishing 1930s prediction, which he was—all we have done here, is apply it the other way round. Instead of agreeing with him, that all mathematics can boil down to just subtraction or multiplication by 10 (or by 2), what we have done is boil all mathematical machines down to these two well-known procedures. Thus, since no mathematics requires more from a machine than the ability to subtract and left-shift, no machine needs do anything more either. This is unexpected, profound, but true.

From which it follows that since you, yourself, can already both subtract and multiply, then it stands to reason that you too can do anything that a computer can possibly do, ever. A conclusion that might seem hard to accept, but which is perfectly true. The only problem is you have to be able to do them 1,000,000,000,000,000,000 times a second, every second, for hours on end. These are called “exaflops” (10^{18},~2^{63})—something machines can do, and humans can only gawp at.

Now this is fundamental to all digital computers, and it follows directly. Speed demands simplicity. It is only by reducing the number of items it ever has to deal with to two, that computers have any chance of speeding up. “0’s” and “1’s” tend to befuddle the human mind—but for machines, they are a godsend. They can be reduced to “yes” or “no”, “left” or “right”, “up” or “down”—it does not matter a hoot what they are, as long as there are only ever two of them. Perhaps contrasting a voltage of three with one of zero might suit, or any other physical difference that human ingenuity can conjure up. Which is why, whereas the first computer I ever wrote a programme for 50 years ago, weighed nine tonnes and occupied half the building—today, the same amount of computing fits into a TV remote control (Cross, 2020).

I do not know what words you would use to describe such an implosion—in terms of the weight of equipment alone that is shrinking 9,000,000 grams down to 9. Humans tend to be impressed by anything even close to such magnitudes—but, and it is an important proviso, do not let superlatives cloud your better judgement.

So, how does a computer calculate? Filled to the brim with binary digits, which can be any physical difference you can dream up—it does only one of two things to them—subtract or left-shift. And here is the next wonder—subtraction can tell sameness. If two things are exactly the same, subtracting the one from the other will, uniquely and always, give zero. And, surprise, surprise, zero is a number which falls neatly into their binary language—is it, or is it not, a “0”?

Do not make the mistake of asking if this involves Truth—it is merely a calculation, one of only two that computers are ever able to do. Subtraction—if the answer is “0”, then the two items compared—are indeed identical. If not, they are not. This does not mean anything more. All it is doing is “solving” that particular item of mathematics. For what happens next, you need to add “meaning”—which no calculating machine can ever do—nor can you, unless you deploy that fuzzy human faculty—‘intent’. Which is the central contention of this paper—without ‘intent’, computers can only endlessly shuffle strings of binary digits, nothing more, nothing less. To make sense, indeed to have any use in our real human world, we have to colour them in—and to do that both consciously and responsibly.

It is called pattern recognition. How does the computer recognise the colour "red", for example, something which our screens show every microsecond? Well, its human programmers give it a number—it is generally something, like "990000_{10}". But, since computers only speak binary that has to be translated into "00001001, 00001001, 00000000, 00000000, 00000000, 0000000"—which takes a while for you or me to read—which is why computing speed is of the essence.

Green and blue have their own number, "009900_{10}", and "000099_{10}", known in the trade as red, green, blue (RGB), which carries an important message for us. We humans have only three colour receptors in our retina, one for each of these primary hues—all the colours of the rainbow can be conveyed by mixing various quantities of each. So, there is no point in computers handling colours in any other way—every single colour screen has "pixels", or very small points of light, which come in only three varieties, red, green, or blue. Mix these in their various proportions, and you can build any colour you like, or at least any colour we humans can see. Note carefully, unless the computer comes out with something which speaks our language, which we can understand, in this case "red", it is talking nonsense—not always easy to see, nor to keep hold of—but a mistake which continues to cost many, much.

Where Binaries Ensure Extinction

Binaries—computers can never escape them—unless *we* do, we are unlikely to survive. Digital computers speak only binary, "yes" or "no", "1" or "0"—if they did not, they would never leave the starting block. Humans on the other hand, hanker after simplicity, similar clarity, "black" or "white", "on" or "off"—so much so, it leads them into lunacy. They stop thinking straight, their conceptions veer so far from reality that they speak nonsense—which matters for all living organisms—any member of the biosphere which insists on being unreal, leaves it. Reality is not pro-life, if anything it is anti-life, it does not owe us a living—if you do not adapt to it, you perish—find food, or starve. Fake-news is toxic. Once, and only once, does binary apply to any and all living organisms—are you alive or dead?

This essentially, was Einstein's problem. His *crie de coeur* was "*God does not play dice with the universe*", and whether your views of God coincide with his, or not, it is vitally important (for your health and mine) that you disagree with him, regarding what electrons do—they do embody "dice", and in spades. He thought there was a single clear-cut solution to life's problems—but there is not. He was convinced, as so many scientists still are, that all you had to do was keep working ever so hard, tackle seemingly unresolvable problems, and a new, clearer simplicity would emerge. But it does not, it has not and it never will. Computers show that clearly enough, to those willing to look. Reality is mushy, it is fuzzy—it does not comply. At heart, it is actually *chaotic*. Humans, and indeed every other living *organism,* survives by undoing this randomness, by *organising* entropy, by consuming fuzzy amounts of inanimate matter or energy, and converting it, for a time, into *organised* life. We humans achieve this by deploying something I am calling 'intent'—I cannot tell you what it is, but I can tell you that without it, we are finished (Johnson, 2018; 2020a). Welcome to Post-Einstein-Science—the Certainty has gone, so needs replacing with realism, responsibility, and trust. Which is why "Truth, Trust and Consent" is vital, globally.

Now when 'intent' falters, when stamina is low, then the yearning for simplicity burgeons. When things become complicated, or threatening, we desperately look for solutions—the simpler the better. Binary sounds wonderful, but it does not apply. So, if your 'intent' is up to it, let's take a closer look at reality, what is out there, what does make sense, and what does not—because it is not always pretty.

Computers are numeric machines. Numbers are fickle, mathematics promises the earth, but falls at the first real count. Poor old Pythagoras was so cross when he found this to be the case, that he labelled his new type of number "irrational". He had been doing so well. Right angled triangles had obliged every time—their hypotenuses invariably followed the same simple mathematical formula involving squares and square roots—what a wonderful pattern—happened every time, mathematical idealism, at last.

But wait, look a little deeper, and the thing collapses, holes appear where they should not, gaps emerge in quite the wrong places—its perfection is punctured, and merges with the rest of the chaos around us. Circles. Who would have thought they could undo something so pristine, and so promising as mathematics? Well they can, and they do.

The tighter you measure the sides of a triangle, then the more beautiful is the symmetry that emerges. Apply the same diligence to circles, and the opposite happens. There is no way you can count the circumference of anything that is round, in precisely the same units as its diameter. To get them to match at all, you have to add a peculiar non-integer factor called π (Pi). And to really rub salt into the wound, this is a number without end. A book was once published which consisted solely of π to a million decimal places, a series that goes on and on, without once repeating itself, ever. Would this indicate that something was amiss? Something begins to smell? We are doing something that does not quite work out the way we imagined?

Perhaps we could limit mathematics to the non-circular? No chance. Anything which rolls, spins, or just goes round and round like any wheel, proves that π is indispensible—and that very fact alone shows the overriding need for non-binary, nuanced thought. Just how troubling π can be, is shown by the Utah State Government which, at one time, legislated that this recalcitrant number would henceforth always equal 3—thereby ensuring none of its engineering ever worked again. Welcome to Post-Einstein-Science, courtesy this time of Pythagoras. Over-reliance on mathematics, and binaries, undermines human meanings, degrades 'intent', thereby threatening more than health.

If π is too arcane, let's go to dividing by 3. I can write ⅓. This is exact, precise, and complete—in this, I achieve a level of precision computers can only dream of—it is that binary again. All digital machines have to make do with 0.33333333_{10}, recurring, i.e., without end, without conclusion, ultimately forever imperfect, inaccurate to a small, but irreducible degree. Not what computers are supposed to admit to—but there it is in black and white, in "0's" and "1's", or, as we need now to add, in grey.

To recap, every single digital computer that was made, or ever will be made, works in binaries—that is how it works, so to expect it to do anything else, costs, both time and enormous quantities of money. And it only ever does two things with those binaries—subtract or left-shift. Everyone, computer expert or not, needs to understand this fundamental digital limitation. It is built into the machine, and however "powerful" or fast they become, all this does is cement these basic characteristics in, ever more firmly. They are here to stay.

So, here is where binaries impact on wider society. All doubters should ask the following question—can computers accurately reflect π perfectly, nothing missing, nothing left out? The real answer, not the fudged one that too many politicians will give you is "no". π is every computer's Achilles Heel. Workarounds are available, indeed they have to be—but watch what has happened—perfection is breached—human trust, individual personal responsibility and 'intent' need to be put centre stage, and need to be kept there, indefinitely, however "computerised" we become.

There are so many political binaries that press to be explored—just think of the last closely run election in either the UK or the USA—but there are others, even worse, to do with race, gender and political affiliation. So, Post-Einstein-Science is not an easy option. It demands extra effort, not less. Look again at what Pythagoras called π—"irrational". I regard it as fuzzy—it is fine in its own right, but not when you put it into a wider, more pragmatic context—then you have to approximate it, you have to use a less than perfect workaround. Mathematicians do not object to this—they take it in their stride. I do exactly the same with 'intent', another item which does not fit with our ordinary verbal definitions—it keeps making it up as it goes along. Here is a crucial human faculty that words cannot keep up with, certainly no binary computer.

And it comes with a whole family of other useful, indeed vital, terms—choice, meaning, purpose, decision, initiative, and art. Do not stick with the rigidity of binaries—have confidence and stamina, and launch into a wonderfully colourful world, where other people's 'intent' is intriguing, open the door to creativity and thence, delight. And keep it open. This is the only available answer to Uncertainty—it is distinctly non-binary, but decidedly human. And it impacts directly on our ability, or otherwise, of avoiding extinction.

There is another binary which cannot avoid being mentioned here—"does it pay—yes or no?" Cash itself is highly emotive. There is a case to be made that money itself is addictive (Johnson, 2019). Democracy too is vulnerable to financial motives, or "intents". Two epochal elections (Brexit in the UK, and Trump in the USA, both in 2016) were corrupted by social media, whose owners were (and are) fixated by their money addiction—at least that is what the evidence shows, the limited amount our governments have agreed to release—transparency, it is not.

Democracy is vital to our long-term political health. And just as personal health relies on accurate information as to what is poisonous and what is not, so politics requires sanitising. Public health measures protect us from cholera—you cannot get cholera if the sanitation is intact—so political measures protect us from autarky—you cannot get purblind governance, if people's voices are heard. Fake-news festers, and rapidly becomes lethal—think the Rohinja in Myanmar or pandemics.

Again, there is much to be learnt from fuzzy words, such as 'intent', choice, and responsibility. Indeed there is also a case to be made that social delight can be used to defeat social harm (Johnson, 2018). But these points all turn on the evidence—do they work? Are they successful, in the real world, in actual realistic practice? Science puts this at the forefront, and initially sets out to function by taking an unbiased, objective, repeatable view—it stumbles over verbal fuzziness, but its idealism is still valid in Post-Einstein-Science, though rather more demanding of our own personal responsibilities, of our "intents".

Computers in Healthcare and Civilisation

I first learnt about Turing in 1967, when, as a junior doctor, I attended one of the earliest medico-computing seminars ever—it was an eye-opener. I can clearly remember my astonishment when the lecturer pointed out that any written word had first to be converted into numerals, since the computer was a number machine. Here was a calculating machine with a difference—it could hold, and as I soon heard, manipulate, letters—an oddity in itself. Next, it could even "subtract" one such carefully entered word, from another. It sounded an odd thing to do. But to my growing amazement, the speaker then succinctly declared that unless the answer was zero, he had no interest in it—because in that event, and only then, it meant that the two words were identical. Subtract and left-shift began to move out from their obscure mathematical shadows to hold real, practical significance.

Later, also in 1967, when accommodating myself to life as a family doctor, I began searching for a weighty intellectual challenge. Which lead me to ponder how computing capabilities could benefit medical practice. Here, Turing's double mantra proved invaluable.

At the time, and since, there has been much talk of these remarkable machines doing away with the professions, in my case clinical practice. They would diagnose. They would “think”. They would prescribe. Goodbye doctors. As Cross (2020) pointed out, this has not happened. As Turing would have told you, it never could. Overgrown calculating machines do what they are told to do, not what we might wish. Any “meaning”, “colour”, or ‘intent’ they display has either already been put into them by their human programmers, or it is not there at all. For computers to “take over the world”, they have first to be instructed to do so, by ego-mad humans—since until then and without them, their stock in trade is just an endless string of “0’s” and “1’s”, as with any other calculating machine.

But back to my healthcare challenge, at the time, we wrote clinical records, longhand and with unreliable legibility on paper, which was then filed, or rather piled on top of itself, without purpose or end. Indeed there are basements in London hospitals where danger signs are erected, warning you not to go too close, because the mountains of old paper medical records stored there could cause injury if they fell on you—which they very well might. The more text, the worse.

If only there was a way of mechanically scanning through these endless quantities of text. What if I could deploy subtraction? If it worked for “red”, how about for “head”. All it would need would be a numerical shorthand that the clinician could use, and the machine could count. So, having a hiatus in my intellectual endeavours, I set about devising a three part numerical code for any and all symptoms that might pass through my family doctor clinic. I ran a pilot version for six months, adding new numbers whenever something occurred that I had not anticipated, nor allowed for. After that, I counted them all up, so was able to boil the numbers down to give priority to higher frequencies of occurrence. In this way, I divided the body, for example, into five major parts, which left plenty of space in the coding structure for references to family members, places of work and other paraphernalia of everyday medical life.

As a result, I can now tell you that pains in the arm were recorded at half the frequency of leg pains (Johnson, 1972). My analysis showed more side effects were reported from one antibiotic than from another, as shown in the following Table 1 (Johnson, 1986).

Table 1

Detailed Reaction to Three Antibiotics

		Reactions					
‘System’ code		*Ampicillin (2879 prescriptions)*		*Oxytetracyline (3931 prescriptions)*		*Co-trimoxazole (665 prescriptions)*	
S30 mental							
S31	insomnia	2	0.7%%				
S32	stress						
S33	anxiety						
S34	irritable	1	0.3%%				
S35	no energy	4	1.4%%	7	1.8%%	7	10.5%%
S36	depressed			1	0.2%%		
S37	phobic						
S38	rambling	2	0.7%%	2	0.5%%		
S39	addiction						
S40 alimentary							
S41	anorexia						
S42	dysphagia					2	0.3%%
S43	nausea	3	1.0%%	5	1.3%%	5	7.5%%
S44	vomiting	6	2.0%%	11	2.8%%	10	15.0%%
S45	dyspepsia	3	1.0%%	3	0.8%%	3	4.5%%
S46	diarrhoea	18	6.0%%	6	1.5%%	2	0.3%%
S47	constipation	4	1.3%%	5	1.3%%	3	4.5%%
S48	‘piles’						
S49	faeces						
S51	rash	15	5.2%%	3	0.7%%	3	4.5%%

Note. %% = rates per thousand prescriptions of named drug.

The conventional wisdom at the time was that oxytetracyline gave more diarrhoea than ampicillin—not so in my data. Further "rambling" was the nearest the pilot six months would allow for hallucinations, and its mention here, following commonly used antibiotics, is intriguing to say the least. Overall, it is difficult to see how this level of clinical detail could be achieved, unless every clinical item, without exception, was recorded (Johnson, 1972). Most "clinical trials" start off by limiting their scope—the notion of recording every single medical consultation, bar none, daunts. However, computer assisted recording obviates this problem entirely—everything is recorded, so everything is available to increase health knowledge, whether you or I thought it important to begin with, or not. Only in this way, can we detect unpredictable side effects—unexpected symptom peaks highlight unknowable correlations, once symptoms are digitised (Johnson, 1986).

In 1990, I even had a working system up and running, which displayed on the screen, the up-to-date price of the drug about to be prescribed (updated regularly by the NHS Prescription Pricing Authority), only to have the project turned down by an official in the Department of Health whose name I happened to know (after which, in 1991, and happily enough for me, I moved on to "re-programming" murderers).

Just recall those mountains of past medical data. What possible value could this quantity of dead data have for you or for me? Well, for one thing, they tell, mutely at the moment, what happened, or what was recorded to have happened to all our predecessors at the hands of the medical profession. And indeed, what is happening at this very minute, for better or worse, medically. What if they could be made to speak, what if their content could become available at the tap of a screen? What a resource that would be, what living history? Healthier? I should say so.

Think back to what has happened to our use of audio and video. They have changed our world by being digitised. Could digitising medical records have as big an impact, not on leisure, but on health? This would be transformation on an epochal scale. It does not call for any new technology, tapping on today's screens is more than adequate—what it does need is a change in approach, and one that is vastly easier now, than it was 50 years ago.

Let's just glimpse at how this would work out in a busy medical practice. Your existing smartphone or tablet uses multi-menus on a touch screen. Such unprecedented technology would enable clinical data to be entered 10 times even a hundred times quicker and easier than writing (or heaven forbid, typing) longhand. Tapping screens is also crucial clinically, not only is it game-changingly quicker, it also enhances eye contact, rather than alienating it.

Bear in mind that in medical practice, as elsewhere, common things occur commonly. Thus, in the six month pilot, there were, for example, sufficient references to "head" to justify a prime slot for that part of human anatomy. Tap on "head" on the screen, and it is selected. Double tap, and you are offered a 10 item submenu of parts, including for example the "ear". Double tap on that again, and you can chose "ear lobe", "ear pinna", or whatever. The scope is adequate, tailored to your particular medical speciality—the screen would offer what you usually use (including any pet synonyms you might crave). The system allows for up to a million distinctly separate symptoms (always including the option to add something that had never occurred before—that's life). *Note very carefully*—the recorder sees only text—the machine only integers—thereby maximising the radically different capabilities of both.

"Head" might make sense for some, "Kopf" or "tête" for others—it makes no difference to the machine, so long as all versions end up with precisely the same numeric. In fact it can go in, in one language, and out in another—"heads" are a common feature of all humanity. Accommodating to what the machine demands, means you need vastly shorter programmes—even simple ones that a single-handed GP could write. Programmes longer than say a million lines, breed bugs exponentially. But note, this at last remedies the gnawing fact that the more text you have, the worse, i.e., the more assiduous you are in data collecting, the less realistic does textual retrieval become, as in today's London hospitals. By contrast, the more integers you have, the better—you simply cannot have too many.

Data-Rich Doctoring

Text to integer—now that is what today's over-grown calculators—are really for. Technically, each symptom would need only the space required for say, five letters, or five bytes. With an estimated 10 symptoms per person, there would be half a billion or so, of such symptoms in the NHS, each year. Globally that could amount to some 70 billion every 12 months. Now quantities of data of this order of magnitude could take at least a billionth of a second to scan, using an exaflop machine—probably less, since they would all be in integers to begin with, with no need for floating points.

Let's cement this in, by taking you through an Einstein-type thought-experiment just to show what a radical difference a new, data-rich medical consultation would be like. You play the patient, I will be the doctor. You sit there, putting into words, as best you can, just what it is that has brought you here in the first place. My central task is to facilitate that process—firstly by establishing trust—I have just made the effort to go to the waiting room, to call you in by name, with a merry quip on my tongue, to melt the ice, if I can risk it.

What happens next? "Listen to the patient, she/he is telling you the diagnosis"—this is how my favourite clinician, William Osler puts it. You are struggling. Let's face it, if you knew all there was to know about what was wrong, why bother asking me? And, sadly for all concerned, there are significant items, especially related to earlier trauma, which do not readily spring to your mind—in fact, though potent, they are actively hidden, and require expert disentangling (Johnson, 2018; 2020b). What relevance does this have to computing? Well, if you are not going to tell *me*, there is simply no way you are going to tell any computer. Computerised medicine without doctors is a recipe for pain.

Empathy, personal contact, interpersonal trust—all vital to successful healthcare, all so far beyond what any computing machine can ever aspire to, as to be laughable. No, human problems need human solutions—fuzziness in symptoms, or rather in causes of symptoms, is, by definition, what diagnoses are all about—the chances of a machine doing this for you, or for me—zero.

So what *can* the machine do? It can regurgitate data—and, once digitised, it can do this by the truckload. And today, we do not even have to wait for ever more fancy gadgets to be invented—even your average smartphone is more than adequate.

So what data do you and I want? You have a history—things have happened to you since you were born, and even before, which could well have an impact on what has gone wrong, medically, now. How relevant is each one of these items? Well the question does not arise, if we have no access to that data. If recorded in text, then access is firmly denied. But if it is all been carefully digitised, we are in for a bonanza.

Not only your entire medical history, long before you were born, but that of every other member of this planet, provided also, that *their* data has been digitised—all at the tap of a screen. Other sufferers will certainly have had what you have now got—same age-sex group, same causative factors, same stage of the disease, or all near enough to be interesting—put their data on the screen, "subtract" your items from any number of others—put it all in a graph, and learn. Common things occur commonly. But note, the computer can detect similarities, identical items—but cannot even begin to "judge", to "opine" that what you have actually got, is subtly different, especially when vital differences are often intrinsically fuzzy. Trust a machine?—not likely.

So, what happens next? Well you came to the doctor to get help, to get something which eased whatever it was that brought you there in the first place. So, I come up with a "remedy". Let's suppose it is reassurance. Would you accept that from a dumb machine? No, nor would I. Now if it is something less fuzzy, and more concrete, such as a particular pill—how can a data-rich consultation help? Well, you can be sure that millions if not billions have already been in your situation, or near enough, and have already had the medicine you are about to be prescribed—so what happened to them? Did it help them? How many of them did it help? How soon did *their* symptoms go? What side-effects did they suffer? How bad? Points I explored earlier (Johnson, 1974).

Ask these highly relevant questions of our current text-based systems, and you would die waiting. Ask it of a data-rich consultation, and the answers, graphically displayed or otherwise, would be there in millionths even billionths of a second. Data manipulation of binaries is what has transformed our world. Audio and video are nothing like what they used to be—digitising them has enhanced our use of them, way beyond anything we could have anticipated. The same is likely to happen to medical practice. Just imagine up-to-the-minute access to every recorded efficacy or indeed side-effect, for the actual drug you are about to receive. Comparing the two, in less than a microsecond, means not only that you and the doctor are vastly better informed, but that both can proceed with much more confidence. This is "real-time" retrieval of clinical data (Johnson, 1980). A data-rich consultation ensures safer prescribing, courtesy of integer machines working smoothly with better supported doctors.

Moving from consulting room to politics, we need to see how a data-rich world could also improve our governance. At present, computerised social media have escaped the checks and balances that finally rescued us from earlier media revolutions. The printing press is now subject to improved legal and social controls—its ability to do harm is thereby curtailed. It is high time social media, too, was taken out of the hands of plutocrats, became subject to democratic law, and thoroughly democratised before it does any more social, health, economic and political damage.

Conclusions

How does this relate to the central topic of this paper? Why is 'intent' so significant? And if it is, where is it adequately defined? What do you mean by 'intent'? When can science tell us the answer? Well this paper is written from a Post-Einstein-Science perspective, that is to say, Uncertainty prevails in the world in which we find ourselves—the only Certainty available comes via the biosphere, where 'intent' makes all the difference (Johnson, 2018; 2020a). If you could tell me what it is that living organisms do, that dead ones do not—then I can begin to tell you what 'intent' means. Meanwhile, being alive, we need to deploy 'intent' to stay that way.

If 'intent' gives you trouble semantically, try "intelligence". Artificial Intelligence (AI) sounds grand, but it's even more difficult to define than 'intent', and rather more stupid. Both terms are fuzzy, but 'intent' offers the possibility of limiting that fuzziness, provided the user exerts her/himself, is responsible, is trust-worthy, and avoids fake-news like the plague.

Now plagues cost, globally, as we are currently discovering. So, health pays. Multibillions are currently wasted because these remarkable machines are grossly misunderstood and therefore expensively and badly misapplied. My view is that they can only subtract and left-shift, whereas we humans can do more—but only if persuaded and encouraged to do so. All computers are in essence binary—something we humans are not. If a better understanding of binary digits can teach us this, that would help. More, if our social and political health could benefit from them, as much as our ordinary health, then we might even survive longer in what is, by any measure, a quite miraculous planet.

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