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Time, Causation and Consciousness

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The nature of time is of particular interest to me because my professional work involves helping people think about the future. This frequently paradoxical line of work has prompted a personal quest to understand more about the nature of time and change, and to ask whether we may be able to discover better ways of looking into the future.

Time and time flow remain a mystery in physics. We might assume that time could be detected and measured, like other aspects of the physical reality around us, but this has not proved possible.

Consciousness is clearly involved in our perception of time. Studies in this area tend to assume that the flow of time is objective and that consciousness reports on it with more or less precision. Most scientific work on this topic therefore focuses on the way the flow of time is represented in the brain and on various aspects of the psychology of time (such as the subjective impression of time passing).

But if time flow cannot be detected physically, and if consciousness is treated as an epiphenomenon of brain function, then it is unlikely that this line of approach will unravel the mystery.

A close examination of the insights about time provided by 20th century physics has led me to the idea that rather than consciousness reporting on time flow, it may instead be responsible for generating the phenomenon of time flow. This is of course a highly speculative conclusion, and in what follows I will explain how I reached it. This is, in effect, an exercise in applying a futures research approach to the topic of the future.

The present state of futures research

Our attempts to anticipate the future depend on what we believe about cause and effect and the nature of time. That is, what do we think the future is, and how is it generated? Our present methods for thinking about or predicting the future can only be as good as our current theories of causation and the nature of time, which explain what brings the future into being. If we are relying on superseded theories – which turns out to be the case – then futures research itself, despite being about the future, is lagging behind even our existing knowledge.

Conventional wisdom holds that the future is inaccessible. It unsettles us because it keeps throwing up surprises that we do not anticipate, which gives us a sense of not being in control. So it remains a perennial source of interest and concern, and frequently serves as a justification for both hope and fear. We would like to predict what the future holds for us, but according to our current beliefs that is not possible.

Even futurists believe prediction is impossible. This is what Peter Bishop, an influential American futurist, wrote in a list of the principles underlying futures work: *“We accept that we cannot know, in a predictive sense, what will happen”*.

Another tenet of belief from the same list reveals the underlying reason for this limitation: *“All professional futurists....see the future as the result of changes in the world.”*¹

There are a number of futures research methods currently used in business and government and they are all essentially grounded on this idea that the future is shaped by physical change happening in the present.

The idea that future outcomes arise from physical forces operating in a material world seems common-sensical. The iconic image of physical change causing the future would be a row of falling dominos, or billiard balls colliding. It is less obvious that this is an essentially mechanical view of causation, deriving its principles from Newtonian science. The Newtonian understanding is that the continual flow of time allows for change, and change is caused by mechanical forces acting on material things in space, resulting in a new physical configuration in the future. The totality of change is irreversible, like eggs breaking, so time is seen as always running from the past into the future.

The modernist vision of futurism derived from Newtonian physics was that if we knew enough about the state of a system, or even the whole world, we would be able to calculate the outcome of all the causal forces at work and be able to predict the future.

¹ Peter Bishop, *The Future of Foresight Working Document*. Association of Professional Futurists, 2013.

The dream of Newtonian prediction was most famously articulated by Laplace in 1814 in a form that later became known as Laplace's Demon. It is worth quoting in detail:

We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.²

This is pure physical determinism, the belief that the material conditions of the past and the present fully determine the future. Physical determinism holds that, in principle, given enough information and a fast enough computer, it should be possible to predict the future. Isaac Asimov, in his famous *Foundation*³ trilogy, imagined a future science of predictive psychohistory which enabled the future to be known in this way.

Unfortunately, in practice and in theory, there are many obstacles to this dream. Any hope of calculating or simulating the forward evolution of the infinitely complex real-world system is stymied by both practical and theoretical constraints – ranging from the mathematically intractable “three body problem” (for example the movement of a planet with a moon around a star) to the loss of the required information about starting conditions due to thermodynamic entropy.

The Santa Fe Institute recently summarized the limits to prediction in a physically-determined system by listing four high-level reasons why prediction is hard, reasons that explain why, for example, weather forecasting is so unreliable:

- 1) the dynamics may be in some sense inherently unpredictable (e.g. chaotic)*
- 2) the financial or energetic cost of measuring the system to sufficient accuracy may be prohibitive,*
- 3) the computational problem of prediction may be difficult (e.g. NP-complete, or worse, uncomputable), even when provided with unlimited data, and/or*
- 4) the state space itself may be unknown, as is the case in systems that adapt, evolve, or innovate.*

² Pierre-Simon Laplace (1814), *A Philosophical Essay on Probabilities*. New York: J. Wiley; London: Chapman & Hall.

³ Isaac Asimov, *Foundation*. Gnome Press, 1951-1953.

*Traditional dynamical systems theory treats (1) and to some extent (2), computational complexity treats (3), and rigorous work on (4) is still ongoing, yet there is very little understanding of the trade-offs and interactions between these four classes of obstacles to prediction.*⁴

As a result Newtonian futurism cannot in principle ever actually get the future right – although it can provide approximations if models are kept bounded and simple – which puts serious limitations on prediction for business strategy and government policy. Despite this rather fundamental drawback the practice of Newtonian foresight continues to enjoy organizational and particularly government support – essentially because some thinking about the future is better than none at all.

Nevertheless, the fundamental understanding that the future cannot be known using Newtonian methods often seems to be absent. This is particularly disturbing in the case of pre-crime. This idea came from Phillip K. Dick's 1956 science fiction short story, *The Minority Report*, in which a special police unit devoted to pre-crime is able to predict future murders and arrest the future killers prior to the crime. Despite the message expressed by the main character, *"if the system can survive only by imprisoning innocent people, then it deserves to be destroyed,"* the notion of pre-crime became popular as a method of counter-terrorism after Steven Spielberg's 2002 film *Minority Report*. In the words of then US Secretary of State, Condoleezza Rice, *"...we have never fought a war like this before where...you can't allow somebody to commit the crime before you detain them. Because if they commit the crime, thousands of innocent people die."*⁵ It is troubling that some high officials seem unable to distinguish between science fiction and what is technically possible in real life – unless of course they are using, on the quiet, a method comparable to the precognitive dreaming that featured in the story.

In the commercial world, Newtonian prediction is currently enjoying a new surge of enthusiasm in the shape of Big Data. This has primarily become popular because of the vast amounts of data that are now available, along with ever faster computers to process it, not because it rests on sound foundations. This approach may well be helpful when it is applied in the context of closed well-understood systems, in other words in situations where external surprise is explicitly assumed away, but it will not be capable of predicting the real unconstrained future.

⁴ The Santa Fe Institute, Limits to Prediction Workshop, August 2016.

⁵ Hudson, S. (2005), 'Rice to Ease Europe's Fears', *The Age*, 30 November: 12.

The field of futures research, which does address the future as an open-ended problem, is aware of these drawbacks and studiously avoids prediction. As Peter Bishop put it:

*All professional futurists....believe that since it is impossible to predict the future, accuracy is not the best measure of successful foresight. Rather foresight builds the capacity to learn about change as quickly as possible and to be flexible enough to respond to that change in creative and effective ways.*⁶

Yet prediction is what we continue to wish for. Scientifically “we know” we can’t have it, so we operate somewhere between the possible and the desired, projecting imagined stories that provide insight but which we know inevitably fall short of the ideal of genuinely knowing what the future holds.

The various methods for futures thinking that do currently exist are part of a conceptual toolkit taught in futures courses and business schools. Business schools like to present management techniques as being grounded in scientific knowledge because this confers authority and respectability. But if there is no scientific basis for accurately predicting the future from within the Newtonian paradigm, this is awkward.

Newtonian mechanics, however, is no longer the last word in physics. So we might well ask if can we do better. Is there anything in the development of physics since Newton that might make the future of future-gazing more successful?

The physics of time

Our existing understanding of time, the story of time that dominates our everyday cultural outlook, is primarily derived from the ideas of Newton. Physics has moved beyond this story, but in ways that are not easy to relate to everyday life.

To appreciate the new story, it is necessary to briefly retrace some key steps in physics as it emerged since Newton and particularly during the 20th century.

The first point to note is that time is a puzzle in physics. We have a strong intuitive sense that time exists, but there is no way to detect it or measure it directly. And even the latest physics cannot explain or account for the flow of time.

⁶ Peter Bishop, *The Future of Foresight Working Document*. Association of Professional Futurists, 2013.

Newton made the assumption, which seemed self-evident to him, that there is an absolute background time in the universe that flows steadily and evenly from past to future.

Absolute, true and mathematical time, of itself, and from its own nature flows equably without regard to anything external...relative, apparent and common time, is some sensible and external...measure of duration by the means of motion, which is commonly used instead of true time...⁷

Within the background framework of absolute time and space, he proposed, mechanical forces act on physical matter, changing it and causing it to take on a new configuration in the future. These simple assumptions allowed the development of mechanics and dynamics, starting with Newton's own laws of motion. This immensely fruitful approach marked the high point of the scientific revolution. It works extremely well for predicting the trajectories of individual cannon balls and planets although, as it gradually turned out, less well for anything more complicated. After a long run of successes, by the late 19th century the Newtonian clockwork universe was finally being called into question by increasingly precise experiments that were probing the underlying structure of physical reality.

Newton himself considered absolute time to be imperceptible and that awareness of time was only possible indirectly through the movement of objects in space. Of course this left open the question of whether moving objects have any direct connection to time: whether these forces must, in some way, "wait" for time in order to act, or whether their action somehow constitutes time. After all, a mechanical clock, which marks time, does not depend on detecting time, nor does it create time, since time does not stop if the clock stops.

By the turn of the 20th century the relationship between clocks and time had been made problematic by the difficulties involved in long distance synchronisation of clocks using electrical signals. This was a practical necessity for complex continental railway timetables, and it was the subject of many patents filed around 1905 when Einstein was working at the Zurich patent office.⁸

Einstein wrestled with the significant paradoxes arising from the unvarying speed of long distance electromagnetic timing signals, specifically when light signals were used as the ultimate method of synchronization. If the speed of light was absolute and unchanging, as experiment had shown it to be, by logical reasoning something

⁷ Sir Isaac Newton, *Philosophiæ Naturalis Principia Mathematica*, 1687.

⁸ Peter Galison (2003), *Einstein's Clocks, Poincaré's Maps*. London: Hodder and Stoughton.

else had to give and Einstein concluded it was time, which was revealed as variable and relative. Hence the Theory of Relativity – the relativity of time.

Einstein came to see time as an extra dimension to be added to the three dimensions of space, producing the concept of spacetime. Time was a space-like fourth dimension which forms an inseparable part of spacetime. This gave rise to the idea of “block time” in a “block universe” – a term first coined by William James⁹ – in which all time exists at once, like space, together forming a motionless block of four dimensional spacetime.

In a block universe time does not flow, it just is, like space. When time is understood this way as a dimension that merely contains temporal events, no one time can be regarded as past, present or future. There is no place in Einstein’s physics for a unique “now” or a common rate of time shared simultaneously by all observers.

The time rate you personally experience depends on your velocity in spacetime. Einstein was not able to explain the sense of a flow of time or detect time objectively, but he proposed that the experienced rate of time can change for individual observers, and in the Theory of Relativity he gave us the conceptual and mathematical tools for comparing and calculating the different relative rates of time that would result from the different physical circumstances of observers, such as very high speeds, acceleration, and the presence of gravitational fields.

Einstein’s new thinking about physics at the start of the 20th century also gave rise to quantum theory, which despite being arguably the most successful physical theory ever, has thrown up some persistent philosophical puzzles. In a sense, quantum theory tells us that there must be something weird about the world, some feature of reality that does not conform to our common sense assumptions about it, but scientists have not yet managed to agree which of the various possible weirdnesses it is.

This disagreement is possible because the mathematics of quantum theory allows several different ways of resolving its incompatibility with our conventional physical picture of reality. As a result there are a dozen or more competing interpretations of quantum theory, each a different way of explaining what the mathematics is saying about the world of experience, and each of which stretch our normal view of reality in a different direction.

The origin of quantum theory lies in the observation that electromagnetic energy is quantized, that it always comes “packaged” in tiny fixed amounts or quanta of

⁹ William James, *A Pluralistic Universe*, Lecture VIII*

energy. In the case of light these quanta are called photons. The quantization of radiating energy requires, by definition, all the energy of each quantum to be delivered instantaneously at a point, because if the energy delivery was spread out in time or space it would be absorbed as a wave which is not what is observed in practice. Experiments show that the energy always arrives in the form of what appear to be point particles. It is of course very strange that energy travels in the form of a wave and is absorbed in the form of a particle. To make this oddness sound vaguely normal it is referred to as wave-particle duality.

There are a number of other very odd things about the way matter and energy behave at the tiny scale of the atom. They are accounted for in the formal structure of quantum theory but they don't make much apparent sense in terms of our ordinary understanding of the world.

One of the central weirdnesses of quantum theory is known as the collapse of the wave function. At the Solvay Conference in 1927, a meeting of leading physicists, Einstein explained this in terms of a thought experiment. How, he wondered, could a wave of energy, spreading out spherically into a large volume of space, gather itself together instantly, or collapse, at the moment when it is absorbed in the form of a particle at a single point location on a detector screen?

No one since has managed to provide a fully persuasive answer to his question, but all the many interpretations that have been put forward each attempt to explain in different ways what quantum theory must be telling us about the nature of reality.

Some of these interpretations have been widely popularized – such as the many worlds interpretation, which mind-bendingly suggests that there is an infinity of other universes branching away from us at every moment. According to this interpretation, the energy of the spreading wave function is actually absorbed at all possible points on the wave-front, and each one of these constitutes one possible outcome in a separate universe that instantly diverges away from the one we find ourselves in.

One of the lesser-known interpretations, the so-called “transactional interpretation”, was put forward by physicist John Cramer at the University of Washington in Seattle. It is interesting because it neatly resolves many of the quantum weirdnesses, but it does so by invoking an unconventional view of time. For this reason other physicists have been slow to accept it, even though in many ways it is much more straightforward than other interpretations.

Cramer has described his interpretation in detail in his book *The Quantum Handshake*.¹⁰ He takes as his starting point the two possible solutions to Maxwell's electromagnetic wave equation, one of which runs forwards and one backwards in time, noting that the backwards-running solution is routinely discarded by physicists as being unreal. He thinks this is an error, and explores the implications of taking the time-reversed solution at face value.

The transactional interpretation is faithful to the mathematical formalism of quantum theory and allows a more conceptually intuitive view of reality than other interpretations, except for one detail: it suggests that the processes of physical reality, mediated by the emission and absorption of electromagnetic radiation, involve transactions or interactions that go both ways in time.

Cramer proposes that a quantum transaction, for example the emission of a photon from an emitter to an absorber, consists first of an “offer” wave moving forward in time from the emitter, followed by a “confirmation” echo wave moving backwards in time from the absorber to the emitter. This leads to a quantum transaction in which a “handshake” wave rapidly builds up between the emitter and absorber culminating in the transfer of a quantum of energy and momentum, which an observer sees as the radiation of a photon from the emitter to the absorber by a wave conventionally moving forward in time.

The difference between this interpretation and our common-sense assumptions is that when electromagnetic waves are emitted in the present, this is “preceded” by signals that flow backwards from the future to the present in preparation for a “pre-agreed” transmission of electromagnetic energy to a distant receiver. This may sound far-fetched, but it is based on theorising first explored by the celebrated physicist Richard Feynman – in the Wheeler-Feynman Absorber Theory – which played a role in the work for which he was awarded the Nobel Prize.¹¹

The transactional interpretation explains the collapse of the wave function as a process of active selection. The offer wave initiates a sequence in which potential absorbers compete to send back the strongest confirmation signal to the emitter. The reason the wave energy arrives at a single point as if it was a particle is because its destination is pre-agreed. In other words there is no collapse but an interactive process that directs the energy.

¹⁰ John G Cramer, *The Quantum Handshake, Entanglement, Nonlocality and Transactions*. Switzerland: Springer International, 2016.

¹¹ http://www.nobelprize.org/nobel_prizes/physics/laureates/1965/feynman-lecture.html

The transactional interpretation is elegant, coherent and consistent with experimental evidence. However, so far, its unconventional view of time is less palatable to other physicists than equally bizarre ideas, for example that of continually-spawning multiple universes in which we are each endlessly duplicated and experience all possible outcomes.

If Cramer is right, the weirdness suggested by the quantum equations is that information and hence influence is constantly flowing from the future to the past, backwards in time. This radically recasts the idea of cause and effect: in this view particles do not collide and propel each other forward in time. Instead, potential futures compete to attract the energy that will be sent forward from the present.

To summarize, physics has presented a shifting story about time: Newton saw time as an absolute flow from past to future; Einstein saw time and space linked, with no fixed rate of time and no place for a unique “now”; and at least one interpretation of quantum theory sees the present as partly determined by the future.

Either science is receding ever further from common sense, or common sense is under increasing challenge and we are slow to respond. Where does this leave our ideas about time? Either we cling to a Newtonian set of assumptions, which it seems we do in practice for everyday purposes, or in technical contexts we apply the principles of relativity and quantum theory without thinking too hard about the implications. Is there a way forward in which we adapt everyday our common-sense assumptions about time to our most advanced knowledge?

Suppose, as a first step, Einstein’s and Cramer’s ideas about time are combined. The result could be thought of as quantum block time. It would be a four-dimensional spacetime filled with quantum transactions. Cramer describes these transactions as space-time standing waves: they would form a web of timeless electromagnetic energy, or light, spanning the whole of spacetime and constituting all the immense complexity of physical events and processes that will ever occur.

From our point of view, time contains everything which moves and changes. But in a sense nothing in block time actually “moves”. Seen from outside block time, from the birds’ eye view of a mythic “super-time”, all the events and movement in space and time would look like static flowing shapes embedded in a block of glass. Physicists call these world lines – a term dating back to Hermann Minkowski – as well as using related terms such as strings and branes.

From a quantum physics point of view, what exactly is it that fills block time? Cramer’s view is that spacetime is filled with quantum transactions, which he refers to as standing waves in spacetime. Ordinary standing waves are formed when wave

energy bounces backwards and forwards in space as time runs forward, for example inside an organ pipe or a microwave oven. With standing waves in spacetime, the bouncing is in time, that is forwards and backwards in time. The mathematical basis for the necessary “advanced” – time reversed – waves has existed in physics going back to James Clerk Maxwell’s electromagnetic wave equations in 1865,¹² and explored again by Hugo Tetrode in 1922,¹³ Paul Dirac in 1938,¹⁴ and John Wheeler and Richard Feynman in 1945,¹⁵ but it usually seemed so outlandish that it was systematically ignored until John Cramer explicitly resuscitated it in 1986.¹⁶

We think of space as empty until an object moves through it, but for transactions to occur backwards and forwards in time, time must already be “full”. This means our future selves “already” occupy all their future times. We could imagine vast linked structures occupying and stretching across time with elements in the present that do not simply point forward to events in the future but are actually part of or linked to those future events, like a vast hidden underwater structure that breaks the surface at a number of seemingly isolated points that we call “events”.

In simpler terms, we can visualize time and the future as filled with events, much as items can be placed on a table top. Such a picture of course raises immediate questions about whether there can be any free will or creativity in such a universe. Surely if all time is “already” full, doesn’t this mean that everything is unavoidably predetermined?

The philosopher Karl Popper reported having a conversation along these lines with Einstein:

Altogether I met him three times. The main topic of our conversation was indeterminism. I tried to persuade him to give up his determinism, which amounted to the view that the world was a four-dimensional Parmenidean block universe in which change was a human illusion, or very nearly so. (He agreed that this had been his view, and while discussing it I called him “Parmenides”.) I argued that if men, or other organisms, could experience change and genuine succession in time, then this was real. It could not be explained away by a theory of the successive rising into our consciousness of time slices which in

¹² Maxwell, James Clerk (1865). "A dynamical theory of the electromagnetic field". Philosophical Transactions of the Royal Society of London. 155: 459–512.

¹³ Tetrode, H. (1922) Zeitschrift für Physik, 10, 317.

¹⁴ Dirac, P.A.M. (1938) Proceedings of the Royal Society of London A, 167, 148.

¹⁵ Wheeler, J.A. and Feynman, R.P. (1945) Reviews of Modern Physics, 17, 157-181.

¹⁶ Cramer, J.G. (1986) Reviews of Modern Physics, 58, 647-687.

*some sense coexist; for this kind of “rising into consciousness” would have precisely the same character as that succession of changes which the theory tries to explain away....Appealing to his own way of expressing things in theological terms, I said: if God had wanted to put everything into the world from the beginning, He would have created a universe without change, without organisms and evolution, and without man and man’s experience of change. But He seems to have thought that a live universe with events unexpected even by Himself would be more interesting than a dead one.*¹⁷

To address these concerns requires first a closer look at causation and then at the role of consciousness in time.

Causation

Causation, or causality, refers to the idea of cause and effect, the way that events are caused in time, and the question of what therefore determines the future. If the applicable concept of time is quantum block time, as described above, then the question becomes, what puts the quantum standing waves into block time, and are they fixed or can they be altered?

Our ideas about causation go back to Aristotle, who put forward a four-fold scheme that is still a recurrent topic of discussion in the philosophy of science.¹⁸ He identified four kinds of cause, or answers to “why” questions, that relate to matter, form, agency, and purpose. These categories can be explained using the example of a house. What he called the material cause (matter) of the house is its building materials, the formal cause (form) is its plan, the efficient cause (agency) is the builder’s skill, and the final cause (purpose) is the owner’s need for shelter.

Today we do not regard all of these categories as bona fide causes because we have so deeply absorbed a worldview that presumes that all real change in the world is primarily physical change – what Aristotle called the efficient cause.

We have inherited this worldview from the era of Newtonian physics, which was the dominant scientific explanation of the world from the mid-seventeenth century to the early twentieth century. The Newtonian perspective is focused on the first and third of Aristotle’s categories – the idea that reality is composed of material stuff that changes as the result of physical force exerted on it. The second and fourth

¹⁷ Karl Popper, *Unended Quest: An Intellectual Autobiography*. La Salle: Open Court Publishing, 1974.

¹⁸ Aristotle, *Metaphysics* Book 5, section 1013a.

categories of change – planning and purpose – are not seen as separate or fundamental types of cause, but simply as preceding mechanical causation.

Our bias towards mechanical causation depends on an assumption that events are inexorably locked into a forward flow of time, that they occur sequentially, and that reality is exclusively composed of solid matter that affects other matter by exerting mechanical force on it – the simplest example being a physical impact. If these assumptions are incorrect, causation is not the result of a sequence of physical changes, as a row of falling dominos would appear to suggest. Although mechanical causation appears obvious at the scale of everyday objects, it is not obvious at the scale of atoms.

Atomic theory was established in the early years of the 20th century, again by Einstein, and it quickly led to quantum theory in the 1920s. But although atoms were conceived of as the smallest components of matter, experiment and theory soon undermined the idea that atoms and particles are tiny chunks of solid substance. What mass they embody is derived from or interconvertible with energy, as shown by Einstein. The wave-particle duality means that atoms and the particles that compose them can be regarded as quantum excitations of their respective fields and the interactions between them as mediated by the exchange of virtual quanta.

According to the transactional interpretation, the exchange of quanta occurs when there is an energy exchange “handshake” between the present and the future. In this interpretation, quantum causation is not a linear forward-in-time process but the result of a “ping and echo” between what is and what will be – consistent with the idea that the contents of the future already exist in block time. The phrase “cause and effect” assumes a one-way forward movement in time, whereas this quantum causation also involves “effect and cause” or retrocausality.

So the contents of future exist at the same time as the contents of the past, and do not exist in time as result of mechanical effort or force. They do not arrive in time through movement because there is no motion in block time – instead, movements fill it in the way objects fill space. The contents of time are not even unambiguously physical objects. Physical matter and motion can both be regarded as consisting of standing waves of light (and other fields) and these fill the past and future as do Cramer’s transaction waves. These light-structures are more similar to images or holograms than physical objects.

If a sequenced event in time is not physically caused then its elements do not depend on one another to exist. The archetypal row of falling dominos forms a single start-to-finish four dimensional structure in block time. A time traveller could reach into the cascade and remove a falling domino at a certain instant in time and

the whole row would still continue to fall. Like a fence with missing slats, the rest of the fence endures. On a larger scale, if a time traveller were to go back in time and kill someone it would not cause that person's descendants to disappear, as the so-called grandfather paradox argues. These are not obvious conclusions, but they are consistent with this story of time emerging from post-Newtonian physics.

If the contents of time are not caused by sequential physical action within time, what does cause them? What puts the events into block time?

If causation is not physical, it must be non-physical. This is simplistic, but it orients us towards possible answers. Aristotle's four causes suggest a way of thinking about this. The four causes taken together comprehensively describe how a conscious biophysical being acts as a cause. As modern science has explored more deeply, what appeared to be material agency (causes one & three) at the immediate macroscopic level turns out at the finest microscopic level to more closely resemble formative intention (causes two & four). It is as if science first revealed the hand and later the mind of God at work. At the first stage we rejected Aristotle's integrated perspective, and now we find once again that it has relevance.

If the cause of the contents of time is not physical agency, could it be the direct formative influence of consciousness? Could images formed in consciousness be capable (under as yet undefined conditions) of directly forming the hologram-like contents of block time?

Consciousness and time

To propose that the contents of time, including the future, are generated from the formative power of consciousness raises further questions. These include an appropriate definition of consciousness and its relevant attributes, the source of consciousness, the relationship of consciousness to time, the apparent restriction of conscious experience within a flow of time, and not least what possible purpose this capability might serve.

As an initial definition, the term consciousness refers to a subjective property of human beings that confers the attributes of awareness, ideation and intentionality.

The attributes of consciousness include the ability to be aware of information and to experience and manipulate patterns of information. Computers have made us familiar with the idea that information can be processed to form visual images and determine the manufacture of physical objects. Holograms can also be created directly from computer-generated patterns of information. This suggests that at least

in principle consciousness has the capacity, through acts of imagination and intention, to generate patterns of information that could form the basis for image-like patterns of energy – such as those that fill spacetime.

However, if consciousness is simply a side effect of physical processes in the brain, an epiphenomenon of matter, then the idea that it could in turn influence the formation of matter amounts to a questionable circular argument. But what if consciousness is independent of matter and is a fundamental attribute of the universe? In philosophy this idea is known as panpsychism and it has a very ancient lineage. In this interpretation, the brain is a consciousness receiver rather than a consciousness generator. Just as the eye receives light or the lungs receive oxygen, brains would be organs capable of making use of another ambient resource, consciousness.

The notion that consciousness is a property of the universe existing independently of biological brains or any material substrate is philosophically plausible. Without co-present consciousness to provide the basis for experience it is unclear how the concept or possibility of existence itself – and hence matter – could even arise.

And if consciousness is a universal attribute rather than an epiphenomenon of matter, or at least of matter organized into biological brains, then again *in principle* it would have the independence from matter that could allow it to influence matter.

At a finer level of detail this hypothesis would explain how images are translated from the mental realm to the physical realm and here Rupert Sheldrake's concept of morphogenic fields comes to mind. A more exotic but parsimonious explanation might be that universal consciousness and space are coextensive or even identical, so that mental images are also automatically images in space. However, this line of speculation lies beyond the scope of the present paper and it is enough to note the potential for this extra step.

Our ordinary consciousness experiences time as a flow, which suggests it is constrained in time. If so, how could it, or something closely related to it, operate across time to form the contents of time? Is there anything to suggest that consciousness has any independence from the flow of time?

As it happens, there is a good deal of anecdotal evidence to suggest that consciousness is not fixed in relation to time.

There are recurrent reports of a human psychic ability to see into the future – the venerable art of scrying or crystal ball-gazing. There are many reports of precognitive experiences, often ones that saved lives during wartime. These

experiences include precognitive dreaming. In the 1920s John W Dunne conducted experiments with precognitive dreaming and developed a related theory of time which he published to acclaim in 1927.¹⁹

There are also reports of experiences in which time appears to stop and all time is present simultaneously in a space-like way – a state that gives meaning to the idea of eternity. Sometimes these are reported as a feature of near-death experiences, and sometimes as part of mystical experiences. The mystic Meister Eckhart, a Dominican friar born in 1260, spoke of a state of knowledge that:

*...knows no yesterday or day before, no morrow or day after (for in eternity there is no yesterday or tomorrow); there is only a present now; the happenings of a thousand years ago, a thousand years to come, are there in the present and the antipodes the same as here.*²⁰

Human precognitive ability was deliberately tapped in a CIA-sponsored remote viewing project that began at the Stanford Research Institute in 1972. The US Department of Defense defined remote viewing as: “the learned ability to transcend space and time, to view persons, places, or things remote in space-time; to gather and report information on the same.” The project ran for many years, gathering a great deal of intelligence that was of critical value in hundreds of cases in which the information was unavailable from any other source.²¹

An element of precognitive ability may also explain the surprising success of so-called superforecasters,²² the top performers in an IARPA forecasting tournament that began in 2011. It was organized by Philip E. Tetlock, decision scientist Barbara Mellers, and Don Moore. The superforecasters had a collective Brier score – a measure of forecasting accuracy – of 0.25, compared with a score of 0.37 for other forecasters.

In summary, there is at least some basis for thinking that consciousness is both universal and to some degree independent of physical, temporal and spatial constraints. This would give consciousness mobility in relation to time, and the capacity to relate not just to a moment in the flow of time but to all time at once. These are basic attributes that would presumably be necessary for any agency capable of influencing time or shaping its contents.

¹⁹ J W Dunne, *An Experiment with Time*, London: Faber, 1927

²⁰ Meister Eckhart, *Sermon XC*, 34.

²¹ David Morehouse, *Remote Viewing*, Boulder: Sounds True, 2008. Joseph McMoneagle, *The Ultimate Time Machine*, Charlottesville: Hampton Roads Publishing, 1998.

²² Philip E. Tetlock, *Superforecasting: The Art and Science of Prediction*. Crown, 2015.

The flow of time

If consciousness is in fact universal and relatively free of constraints in time, and if time is a static dimension in the block universe, what accounts for the ordinary conscious experience that time is a continuous one-way flow in a three-dimensional universe?

It might be thought that physics would disclose a single common “now” sweeping like a shock front through the block universe, turning the future irrevocably into the past. Instead Einstein showed that two events could be experienced as simultaneous by one observer and as occurring at separate times by another. This meant the rate of time was malleable and could be different for different observers – although this only becomes evident if they are travelling at substantially different speeds.

The reason Einstein was able to show that the rate of time could differ for different observers was that the speed of light had been measured as invariant under all conditions. Indeed, he originally wanted to call his theory “invariance” not “relativity”. This invariance was surprising, as it is not true for, say, the speed of a bullet fired from a fast-moving train, where the speed of the train is added to or subtracted from the speed of the bullet. Einstein showed that if the speed of light is invariant, then logically time must be variable because something has to give – although it has to be said that proposing this logic required considerable chutzpah because it completely defied common sense.

The variability of time led him to treat it as an inseparable part of a flexible spacetime. But in a block universe time does not flow, it just exists, bent or otherwise, like space. As a result, there is no place in Einstein’s physics for a unique “now” shared simultaneously by all observers. As he put it in his book *Relativity*:

*...there exist in this four dimensional structure no longer any sections which represent “now” objectively.*²³

In sharp contrast, the concept of “now” is important in philosophy (and one might add, spirituality), and Einstein’s ideas met with considerable resistance from philosophers. In particular he was challenged by Henri Bergson, the preeminent philosopher of time in the early 20th century, who had concluded that our experience of time is intrinsically related to consciousness. There was a celebrated public

²³ Albert Einstein, *Relativity*. Methuen, 1916.

encounter between Einstein and Bergson in Paris in 1922 at which the two men debated the nature of time. At this meeting Einstein, the brilliant rising celebrity, provocatively declared to his audience of philosophers that “the time of the philosophers does not exist”²⁴ and managed to upstage the eminent Bergson, whose fame and influence declined in the years that followed. Yet the issues they debated – the differences between physical and psychological time – still remain problematic.

Psychologically our consciousness of time is always a consciousness of the present, of a “now”. In fact, our consciousness of time is, if we focus on it, not so much an awareness of a flow as of an all-embracing unmoving “now”. Bergson argued that the psychological sense of duration is a better way to understand time than the idea of incremental time as a succession of instants, which we get by focusing on change.²⁵

Possibly the sense of an enduring now may be the primary time experience of consciousness, and the sense of flow secondary. In any case, according to Einstein our “now perception” is not bound to a unique and shared present moment in absolute time, which is the concept of now that gave him insurmountable logical difficulties.

The picture of the conscious experience of time that emerges from Einstein’s perspective is that each observer is at the centre of their own perception of flow time and experiences a “now” that is unique to them. They do not experience a shared “now” that is common to all observers. There is no place in Einsteinian physics for any single “now” occurring at a particular point in time, which is how we usually think of it. Yet if consciousness is not produced in concert with a common physically-based “now” that moves through time, how does it include a sense of a present moment or of time passing at all?

This is problematic if consciousness is considered to be a side-product of physical processes. But if consciousness is a fundamental attribute of the universe that inheres in biological brains, maybe in that constrained form it is able to salami-slice through block time to produce the experience of time passing for that particular observer. In other words, consciousness appears to move in time not because it is a product of physical processes embedded in time but because it is able to participate

²⁴ Jimena Canales, *The Physicist and the Philosopher: Einstein, Bergson, and the Debate That Changed Our Understanding of Time*. Princeton University Press, 2015.

²⁵ Henri Bergson, *Key Writings*. Bloomsbury, 2002.

in them, at the rate, according to recent research, of one slice every 400 milliseconds.²⁶

In this case, the impression that time passes is not due to any movement of the time dimension itself, but to the tracking of biologically-focused consciousness through time. If so, once partial consciousness is focused into a biological brain, does it then move through time at a predictably steady rate?

In relativity theory the velocity relationship between time and the speed of light is known as the four-velocity (the three dimensions of space and one of time) and it describes what happens to time flow when velocity in space changes. It implies the fairly bizarre idea that when an object, or an observer, is at rest in space they have a velocity of c , the velocity of light, in the time dimension. This is a mathematical result that is not usually taken literally because it is not clear what it means. But perhaps it is worth taking seriously.

Suppose that once a subset of consciousness enters time by occupying a biological brain that it literally does then travel through time at the speed of light. Maybe the apparent invariance of the speed of light is not to do with light, but with an invariance in the velocity of consciousness? As consciousness tracks forward along the world lines of quantum transactions, maybe it translates them from standing waves in block time into the experience of light waves moving forward in flow time at the same speed as consciousness, which we then call the speed of light. Because consciousness is by definition the absolute reference for experience, we then experience the velocity of light as invariant. That is, the velocities of consciousness and light form a reciprocal relationship but since we experience the world through consciousness we have been biased to view the velocity relationship the wrong way round.

Thus the individual consciousness of an observer tracks through block time like the steady movement of a laser beam across a CD or the needle on a gramophone, which can be lifted up and moved to a different place on the vinyl disc. There is no special playing place or musical now. Different observers at all times and all places in block time simply experience time flow in relation to the vicinity and velocity of their tightly-focussed now perception.

Spacetime is vast, and quantum transactions are tiny, so the total collection of standing waves in block time that consciousness could potentially follow would form an immensely complex interwoven web. Seen from within time, each quantum transaction would represent the path forward in time of a particle, such as a photon.

²⁶ Herzog MH, Kammer T, Scharnowski F (2016) Time Slices: What Is the Duration of a Percept? PLoS Biol 14(4): e1002433. doi:10.1371/journal.pbio.1002433

Vast bundles of collectively moving paths would represent the movement in time of physical matter. The whole array of paths might resemble a vast three dimensional road system traced out in the time dimension.

In this speculative picture, our consciousness is first focused into time through the process of biological birth, after which we are locked into a steady movement forward in time. The path from birth to death of a biological organism, otherwise known affectionately in physics as an observer, is then something roughly like a highly complex route selected on a sat-nav map in a car. Just as with the sat-nav, fixed beginning and end points must be set for a route to be selected. In the case of the sat-nav, the road system usually allows two or three different routes to the endpoint, which can be selected by the driver. Some variation is possible, but not very much if the chosen journey is to be made.

If this is indeed how time works, are we in a similar situation – do we have any choice over the path our lives take?

Choices in time

The value of thinking about the future is generally thought to be that by looking ahead we can choose a better future path. For this to be possible, for our lives to take a different path, either the contents of future time must be changeable, or we must be able to take a different path in a network of potential routes that already exist.

If the contents of time and the future resemble objects on a table top, then just as we can choose to close our eyes and run a fingertip or hand over the table surface to “experience” what exists there in a linear sequence, then so the sense of flow and directionality in time may arise from the way our consciousness is focused. Alternatively, we can stand back and look at the table as a whole. From this vantage point we can reach out and move the objects on the tabletop, or remove them, or place new objects.

This analogy suggests that an overview of time may be possible from the vantage point of universal consciousness, but that time will be experienced as a linear flow from within biological consciousness. It also suggests that whatever agency fills time, and possibly alters time, does so from outside block time and with the advantage of an overview of time.

This perspective would, incidentally, resolve the disagreement between Popper and Einstein, in that determinism would indeed apply at the level of biological

consciousness in block time, but indeterminism would apply at the level of universal consciousness outside block time.

The question of whether direct awareness of the future is possible for biologically focused consciousness would appear to depend on whether a link can be established between biological consciousness and higher consciousness, either via an aspect of the self outside time or a more general superconsciousness. Both the widely reported human precognitive ability and the success of the CIA remote viewing project suggests that this link can be established, at least by some people some of the time.

But what agency actually generates the patterns of energy that fill spacetime? Can we presume that if it can fill spacetime in the first place that it can also change it? In other words, is the future fixed and closed, or fluid and open? And if it is changeable can we access this potential openness from the biological level of consciousness within time?

The agency may be consciousness itself, exercising the pure power of creative imagery, or it could be a closely allied form of agency that is actuated by consciousness and operates alongside it. Possibly the power of mental imagery operates like Aristotle's "final" cause, purpose, which comes one step before a blueprint. Maybe mental images, if clearly and strongly enough focused, can shape the light-stuff of potentials in time, and actually are or become the contents of time and the future. Alternatively there may be some intermediary step, equivalent to Aristotle's "formative" second cause, perhaps similar to the concept of a morphogenic field.

Continuing with this line of speculation, once these morphogenic causes are formed by consciousness where, or rather when, would they act or operate? Not in the immediate present of the biological consciousness, presumably, as the present is the pre-existing canvas on which the new is to be painted. Logically, their mode of action would be to take form in the future of the biological consciousness, acting in some sense as an attractor for the path of the present.

Maybe once these potentials come into being they then literally signal their existence to the present, as the transactional interpretation of quantum theory proposes. Quantum block time could then be understood as being filled with future potentials, actively vying to draw the energy of the present towards them, or more precisely signalling for a focus of consciousness to move along the world line towards them to experience them.

As with the concept of a universal and a biologically focused consciousness, it may be that the source of agency also has a greater and lesser form too. Possibly the greatest power to shape time exists at the more comprehensive level, outside time. Maybe this relationship between the two is cooperative and serves a purpose.

Possibly genuine free will operates largely at the level of higher consciousness, and biological experience within time is similar to a structured curriculum of experiences for the purpose of learning. Maybe the biological self is not intended to change the curriculum too much as it provides a learning process for consciousness as a whole. Maybe there are a few optional pathways in time that yield an equivalent educational journey. Maybe like the waypoints on a sat-nav map, there are some junctures where key routes intersect and it is possible to choose a slightly different but equivalent experience.

In this case the wisest stance for biological consciousness would be to accept its destined time path to maximize learning, or at least avoid shying away from the curriculum and having to repeat it.

Science, however, does not often pause for the sake of wisdom, but continues to advance inexorably. It is entirely plausible that further advances in physics will confer the technological power to know or even change the future, possibly allowing human beings to disrupt time itself.

A future technology of the future

As things stand, the insights into time provided by relativity and quantum theory transform our understanding of time but do not make the future any more accessible than Newtonian physics did. Nevertheless there is a real possibility that future quantum technology may revolutionize our relationship with the future.

According to the transactional interpretation of quantum theory there are energy exchanges and possibly information transfer between the future and the present. This should provide encouragement for remote viewers, and it may turn out to provide an explanation for human precognitive ability.

Furthermore, it is possible that technology for information transfer across time or movement in time may prove technically possible. Possibly we may learn how to intervene directly in the future by technological means. At a minimum a future trans-temporal physics may discover how consciousness is able to move and focus in time, leading to technology for directly viewing the future.

If that proves to be true, we would finally have a technical means of looking into the future itself rather than simply speculating about it. What might we be expected to learn from the use of such a device? We would, of course, learn the content of the future. But this would not be all.

My experience as a professional futurist, and my speculations here, suggest that we would find ourselves learning a critical personal and social truth. We would see the extent to which the future is changeable. By focusing on different possible choices and actions, we would see our future change in response.

The true value of this ability to view the “real” future would prove to be, I believe, that it would serve as a moral mirror – perhaps to the consternation of those who hope that knowing the future will give them a means of worldly dominion. On the contrary, the ultimate value of seeing the future would be to understand the consequences of our actions and, if morally chastening, to choose differently.

ENDS