



## The Physical Basis of Mental Life II: Special Relativity and the Brain

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### Introduction

This is a continuation of a previous article submitted here to develop a hypothesis regarding the nature of Consciousness amenable to the scientific method whilst taking care not to veer off into metaphysics or theology. Yet, it would be metaphysics precisely that I wish to persuade into reasonable scientific certainty or at minimum render moot herein, to the fullest extent possible, since the advancement of our scientific understanding of the mind depends on authentically incorporating as much as possible, philosophy into science; the Theory of Knowledge demands no less.

It is in this spirit and by way of sharpening my intent that I proffer a description of mental life that hopefully encompasses a deeper understanding of the ‘substance’ of consciousness or at least, as these debates tend to take on an eternal life of their own, capture much of it in the language of quantum mechanics and physics. But first some background in philosophy of mind, what else?

### I think, therefore I am.- Rene Descartes

With this phrase, one of the greatest philosophers of mind, Rene Descartes (1596-1650) [1] proclaims the undeniability of his existence in the universe. Undeniable because by his reasoning, he may plausibly call into question the existence of everything around him, in fact everything in the universe, as the product of say, a demonic entity hellbent on deceiving him, he may even question the veracity of his own beliefs as a product or outgrowth of the ‘Matrix’ but what he may not doubt is his own doubting because that undoubtably would still leave him doubting-thinking that is [1,2]. Since the agency or independence of his thoughts, as distinct and certain in this way, is the one thing that by collapsing in on itself must be true, his existence must also be true. I think, therefore I am.

Having established himself as a conscious entity with mental life, Descartes proceeds to frame the problem in terms of two types of ‘stuff’, the mental and the physical, mind/matter duality, wherein the former somehow interacts with the latter. Without recapitulating the entire history of philosophy of mind, suffice to say that some 370+ years after Descartes the jury is still out on Cartesian duality; specifically, how ‘the mind’, lacking any physical substance, can possibly interact with the physical, even while knowing full well that it does. The prevailing contemporary models find commonality in the functional theories of mind [2] where the mind is viewed as “brain states” in series or as a neural network overlaid on its brain understructure leading to some functional outcome or purpose much as a computer software runs on computer hardware circuitry producing an output. Think of a hand made into a fist, the fist being a conformation of the hand for a specific purpose yet not existing independent of it [2].

Critics of the functional approach to mind and consciousness are quick to point out that a brain state defined by function alone cannot possibly

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capture subjective experience [2] such as what it is like to experience a sunrise, an ocean view, or a stadium of 100,000 noisy partisans. As such they argue, it is incomplete, omitting the very thing it attempts to describe, consciousness. There must be more to it than mere function they argue. I agree. It is meaning given to conscious experience as it pertains to an individual in a given space, time and circumstance, i.e., the appreciation of the experience, plus whatever function derived from the state of brain that led to the experience, in its entirety, that counts as consciousness. Any theory that cannot account for all aspects of consciousness including quiet enjoyment is either incomplete or an anti-theory, an argument against a separate thing in the mental realm called consciousness and its corollary, free will [3].

The Functionalist rebuttal is noteworthy, however. It argues that neurophysiological organization of the brain towards a functional result intrinsically generates, by accident or evolution, consciousness and conscious experience; the functioning brain yields a (physical) whole that is greater than the sum of its parts. Whether any of this is by evolution, design, or chance, or even whether any of it is true is no concern of mine. What is of interest to me is could it be true and if so, how would you prove it? Re-stating the problem, if consciousness is something that the brain serves up in integrating functional brain states into a physiologic whole, could it be that (the experience of having) consciousness is not 'mental' at all? Might it not be subsumed under biology, specifically neurobiology? If biology reduces to chemistry, chemistry to physics and physics to quantum mechanics/physics [1], might we not then have the basis for a scientific theory of consciousness whose truth or falsity could be objectively verified by the scientific method?

### The Mind as Quantum Time Machine

Several neurological phenomena in normal brains as well as psychologically abnormal brains, point to potential explanations of consciousness in terms of the laws of physics, specifically the physics of Einstein's special relativity as it applies [4], to the microscopic world of quantum physics. Anyone familiar with the theory of special relativity would be familiar with the terms time dilation, time relative to a moving body, length contraction, proper length in a moving frame at relativistic speeds and so on. While these terms have been in use mostly to describe the macroscopic world of objects traveling at high speed, it is interesting to extrapolate how they would apply to the microscopic environment of the brain-the quantum brain, and what it would imply for the mind. If we accept the proposition that consciousness, conscious thought, occurs as an epiphenomenon of brain then could it be that in this neural network, this hologram that is the mind, electrons approach relativistic speeds producing time dilation and all other effects of the special relativity?

Consider the example of what has been referred to as

the cutaneous rabbit [2]. Applying pressure at a point on the forearm results in the localized sensation of touch or pressure at that point. Applying sequential pressure at different points along the forearm results in the pressure being felt at locations in between, as in a rabbit running across your forearm. The brain somehow "filled in" the extra sensation of pressure at points in between where pressure was applied. What's going on here? tactile illusions? You might say that, since no pressure was applied. After all, how could you have felt a sensation where no pressure was applied? Yet, there could be a better explanation. What body and brain tell the mind and what the mind experiences might be two, in this case three, very different things. This could be because the mind can dilate time. Indeed, since the brain needs time to process stimuli and send it on to the mind, time dilation might be a required feature of consciousness, necessary to view the external world as continuous rather than frame by frame. Recall that for an object travelling at relativistic speeds relative to earth, it slows down relative to earth time [4] as expressed by the Lorentz transformation [5], so that for example, 3 seconds of 'earth time' is compressed into 1 second or put another way, for every 1 second that passes on a spaceship launched from earth, 3 seconds pass on a stationary clock on earth. As a result, stimuli from the cutaneous rabbit would occur much closer in time than the mind perceives so what you see happening (in 'mind' time) has already occurred and is in the past. What effect would this have on perception? Physics says everything has a wave function, which means anything may behave as a particle or a wave. The pressure sensations that would ordinarily be felt separately at discrete locations on the skin of the forearm may be, due to time dilation, now felt as a force wave with an interference pattern. The sensation is generated in between where the force waves reinforce each other even though no pressure was directly applied there. Local numbing may not abolish this pressure sensation. Not only that but because of differences in processing speed by the special senses, e.g., touch vs. sight, what is seen and what is felt are out of phase by the time each are consciously perceived. Because the perception of sight and touch are staggered in consciousness by the differences in processing speed (Newtonian physics), an extra sensation is produced at the position where pressure was applied on your forearm which your conscious mind is only now able to sense. You also feel sensation at the point on your (proper length) forearm because your conscious mind has taught itself that perception of touch and sight should, wherever possible, occur together. Remember, if time is dilated in the mind, then proper length (meaning length to your mind) is elongated. There are no absolute frames of reference and your physical body, biology and physiologic processes, governed mostly by Newtonian laws, are in this hypothesis, postulated to be in a different frame of reference than your mind. Preposterous! -you might say, because your body is a constituent part of you and therefore must be in the

same frame, or if not then it would appear contracted. No, I will argue in return, it is the *perception* (proper length) of your body (and the environment) that is in the same frame as your mind, not your body itself but whose perception must also be regarded as *physical* (a phenomenon of special relativity and quantum mechanics), for this model to be sustainable; the environment and your body *is* in a different frame and yes, *contracted*.

## The Mad Hatter- Don't Go Away Mad, Just Go Away

To better appreciate this paradigm, consider that effects like the above can be observed with other special senses. Consider the visual phenomenon of a piece of paper with a pattern and an X on it. When the mark is centered over the blind spot, it disappears yet there is no gap or interruption in whatever pattern was there in the background. This speaks against it being an optical illusion. Perhaps this effect could be better explained by the difference in angle subtended by an elongated (proper length) piece of paper (as seen by the mind) and its contracted ('real' time) length. Since the contracted x subtends at a wider angle, when over the blind spot it disappears into the pattern on the piece of paper giving the appearance of a sensory illusion.

But if they are not illusions then what are they [6]? The answer gets to the heart of the central dilemma that has vexed many scientists and at least one psychiatrist; and it is of course, stated in the form of a question: Is it a particle or is it a wave [7-9]? If this appears at first blush off the topic, or worse, like we have the substrate for another debate about reality, rest assured that yes, we do [6] but that is not where this discussion is headed. Like Descartes and in tribute to him, my interest is in demonstrating a specific reality, that thinking, specifically my thinking and the mind that thinks my thoughts is real, undoubtable and privileged to me [1]. But to do so in the digital age requires a step beyond simply retracing Descartes' exercises of logic, it would require proof, physical proof of my capacity to think, and of my mind. As with Descartes, if I establish this as independently true by modern standards, then many other truths may follow from it and the cause of science and medicine hopefully nudged forward. It is no less of a gargantuan endeavor than to attempt to epistemologically satisfy, not by the logic of philosophy but with science, the question what is consciousness?

We know what we know because the scientific method provides us with objective and reproducible evidence that our knowledge is accurate, yet we still must believe the evidence. How then to convincingly make a case for the objective existence of something essentially understood as subjective; a contradiction to which I offer the same reply (in the form of a question): Is it a wave or is it a particle? Consider the Heisenberg uncertainty principle [4] of chemistry and

quantum physics fame. It states among other things, one can observe a particle's location but not its momentum (where it's going), conversely if a particle's momentum is measurable then you cannot know its location. In other words, because the act of measurement disturbs the subject of measurement [4] you cannot observe both the location and momentum of a particle at the same time the way that you can observe a homerun ball travelling over the green monster at Fenway Park.

## Go Ask Alice

To be sure, people who study this stuff and take their science very seriously appear to take a functionalist approach to it by accepting by observation that it can be either/or and if science can be done fine without going any deeper, were it even possible, then it doesn't matter. True enough, unless perhaps, you are trying to establish an evidentiary basis for consciousness, then you must provide an explanation that gets underneath it all, one that takes into account consciousness. Such an explanation, if true, would provide the proof needed that not only is consciousness real, but it is physically real, governed by the same physical laws as anything else.

Here it is. If you accept the proposition that the mind exists physically, then what the special senses tell us and what the mind perceives must be very different. Repeat MUST be different to establish physical evidence of mental life. It gets tricky here because if you cannot believe what your senses tell you then what can you believe? I think therefore I am is sufficient, thank you. Rene Descartes has already been there ahead of us so let's lean on him and work forward by induction. If we exist by virtue of our consciousness, then consciousness itself exists. If we can discard the notion of the mental as distinct from the physical, consciousness is something physical. To exist at all therefore, it must differentiate from the understructure of function and neuroanatomy it is in meta position to. This MUST be true, since it would meld into and become indistinguishable from its physical and functional understructure were it NOT true. The differentiation is in form of what special relativity tells us about time and length, specifically time dilation and length contraction generated by movement of electrons at relativistic speeds. We have thus established the principles of Einstein's theory of special relativity as a requirement for and as the basis of perhaps an entirely physical theory of consciousness. Let us move on to seek means of proof.

## A Magic Carpet Ride?

Since the ability to dilate time is the hallmark of this model, there is at least one ratio of relative time that is relevant to it and that is time as it passes in the conscious mind vs time as it passes in the brain. Which for the sake of simplicity and clarity we will consider to be the same as earth time. The problem can be set as  $t_{\text{conscious self}} : t_{\text{brain}}$  or  $t_s$  :

$t_{earth}$  where : represents the ratio and  $t_{brain} = t_{earth}$ . The Lorentz equation for time dilation mathematically elaborates this as  $t_b = t_s \times 1/\sqrt{1-v^2/c^2}$  where  $v$ = velocity (of electrons, particles), and  $c$ =speed of light which for simplicity we can express as:

$$t_s / t_b = q, \text{ time dilation quotient.}$$

The actual numbers are not important at the moment, what is most important is to drive home the concepts. For example, if for every 1 second that passes in the perception of the conscious mind, 3 seconds pass on earth the ratio is 1/3. If you accept the commonly held premise in physics that everything in the universe is essentially granular [10], then external ‘reality’ is digital, particles that the mind only perceives as analog, as a continuous wave, because of the limits of our conscious perception, limits defined by  $t_s/t_b$  a time dilation quotient. The smaller the quotient the higher the propensity for conscious thought, but also, to perceive things as continuous not discrete [11].

Consider the case of the auditory rabbit [2,12]. The auditory rabbit is like the cutaneous rabbit but involves only one special sense, hearing. Two widely spaced speakers generate a series of equally balanced clicking sounds but which the mind perceives as an even series moving across the space in between. What we have are stimuli of the same type (sound), travelling at the same speed (speed of sound) but evenly staggered in time.

Consider next the cosine waves. If two such waves are in phase and put in superposition, they reinforce each other, meaning the amplitude of the two together is just their sum. If the waves are staggered, they are out of phase by a phase shift factor, given, in our example, by the signal processing time difference between left and right ear which ordinarily allows the brain to localize a sound. It can be expressed as:

$$\Delta p = \omega(p_2 - p_1) / \omega$$

where  $\Delta p$ = stagger or shift, given by the difference in time between stimulus hitting the closest ear and stimulus at ear furthest away and,

$$\omega = \text{frequency, } f \times 2\pi,$$

$p_1$ = processing time of ear closer to sound source,  $p_2$ = processing time of ear furthest from sound source.

The sound wave of each click in each ear can be expressed mathematically as  $\cos \omega t_s + \cos[\omega(t_s \pm \Delta p)]$ . Therefore, the combined (superposition) wave is their summation (presuming the speakers are equidistant from the observer):

$$\Psi(t_s) = 2 [(\cos \omega t_s)] + \cos [\omega(t_s - \Delta p)] + \cos[\omega(t_s + \Delta p)] \text{ where } \Psi = \text{wave amplitude as a function of } t_s.$$

No further mathematical elaborations need be done for the moment because we just want to know whether substituting  $t_b$  for  $t_s$  would make a perceptual difference to the mind in terms

of displacement. If it does, then perhaps therein lies the proof that the proposed model of consciousness is correct.

You can conceptually accomplish this by recasting the time dilation ratio,  $q$  as close to unity as possible. Let’s think about it for a minute. Altering the numerator, like a trip on LSD would still yield a subjective result; not the proof we’re looking for, so put away the hallucinogens and come with me on a trip following the arithmetic instead. You can change the denominator but that wouldn’t change the ratio since your mind is stuck onto your brain and the alternatives patently ridiculous if not impossible with current methods. But hold on for a minute; what if you could insert a proxy that simulates as the numerator? Then it would be theoretically possible to change the ratio by dialing the proxy up or down like a knob on an electronic device. Physics says that the speed of any wave is dependent on the medium through which it travels not on its source. Sound therefore could be our proxy. The objective is to simulate  $t_b$  by using the properties of sound waves, i.e. contract or shorten the cycle distance or wavelength of each wave (the cycle distance is the distance traveled by one cycle of the wave) to be as close to what  $t_b$  (not your mind) says it should be. Since the speed of sound through air is invariant, the frequency  $f$ , would also increase, exactly what you see with the doppler effect. If you could account for any interfering sounds, you could make use of the doppler effect by moving the sound source towards you at a velocity given by the product of the time dilation quotient multiplied by the speed of sound:

$$v' = q \times s \text{ or } v' = t_s/t_b \times s \text{ where,}$$

$$q = \text{time dilation quotient, } (\sqrt{1-v^2/c^2})$$

$$s = \text{speed of sound (760 miles/hr).}$$

$$v' = \text{velocity of sound source travelling towards you.}$$

Of course, it would be much easier to just increase the pitch (frequency) of the sounds from the speakers as follows:

$$\omega = \omega_0 \frac{1}{1-q} \text{ where } \omega_0 = \text{original frequency, } \omega = \text{new frequency and } q \text{ is presumed to be } < 1.$$

If at  $\omega$  (or  $v'$ ) the sound is perceived as not just higher in pitch but as it is generated, equally balanced, it could provide a basis for further exploration. Of course, you could always argue that it would simply be due to varying the pitch (or wavelength  $\lambda$ , whichever you prefer) and the effect reestablished at a different angle. Thurlow, et al. [12] demonstrated these effects on perceived displacement by placing speakers at different angles [12]. Geometrically, points of constructive or destructive interference are given by the approximation:

$$m\lambda = d_1 \sin\theta$$

$$\text{where } \lambda = \text{wavelength, } d_1 = \text{space between speakers (the}$$

two sound sources),  $\theta$ =angle between observer and sound sources, and  $m= 0, \pm 1, \pm 2, \pm 3$ , etc. (integers) for constructive interference etc. [5]

We are also of course, dealing with the angle created by the distance between each ear,  $d_0$  and each sound source. If the wavelength,  $\lambda$  is varied, the angle,  $\theta$  at which the first displacement effect or first minimum (destructive interference) and so on would occur would be different, which is Thurlow et al.'s finding [12].

The question is, if you repeated this experiment in a different sound medium (where the speed of sound is varied), simulating a variance in the denominator of the time dilation quotient, would a difference in wavelength disproportionate to the relative difference in medium at which the first minimum or variation or abolishment of the saltation (displacement) effect occurred constitute evidence that the time dilation model of conscious perception is correct? Because the mind is postulated here to be a physical constituent and quantum epiphenomenal [3] part of the brain, perhaps no fancy mathematics beyond here should be required to demonstrate its characteristics, save perhaps for the derivation of the numeric value of  $q$ , the conversion factor or slope of the mind/matter function; the equivalent of  $\Upsilon$  in the Lorenz transformation. Cartesian duality seems to be correct after all, at least a form of it. In subsequent writings I will lay out in greater detail what that means, as I understand it, for brains and minds.

1. If I have seen further, it is by standing on the shoulders of Giants-Isaac Newton

For those with insatiable curiosity, the Universe gives back a hundredfold in large measure because of the accumulated knowledge of all those who came before us [1]. That is Epistemology, the Theory of Knowledge in a nutshell [13,14]. To the extent that this article delivers on that premise to an even miniscule degree I am humbled and delighted to no end, because I believe the Universe has a lot to teach us and we've only just begun.

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