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Decision-Making and the Time Paradigm Problem: A Commentary on the Free Will/Determinism Debate

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Abstract

A significant debate on decision-making and the notion of free-will has been shifted in the neuroscience community towards a deterministic nature due to previous experiments demonstrating brain activity engagement prior to conscious decision-making. However, modern interpretations of physical reality pertaining to quantum and relativistic theories has created complicated and controversial views of time. These views have vast implications within the scientific method that are referred to within as the Time Paradigm Problem. This essay explores the relationship between time and charge by revisiting the development of modern physical theory within a historical context. In doing so, an alternative interpretation of the charge-time relationship has been presented within a time-symmetrical nature that postulates a "unification" of time and charge. Within this context, previous neuroscientific results presenting a deterministic nature are reinterpreted colloquially to suggest these results may be an artifact of the experimental design and a consequence of misunderstanding nature's time.

***Keywords**: Decision-making; Time; Charge; Symmetry; Neuroscience; Physics; Time Paradigm Problem*

Introduction

Decision-making

Decision-making has long been at the center of the philosophical debate about whether nature is deterministic or whether humans exercise free will. In the 1980's, neuroscientist Benjamin Libet and colleagues provided evidence that the human brain engages activity prior to any conscious awareness of a person's decision to perform a movement [1-3]. Much of the neuroscience community has accepted their results as support for the notion that a deterministic nature creates an illusionary free will [4,5], which subsequent experiments utilising more advanced technologies reproduced [6-8]. Conversely, there have also been scientific and philosophical arguments put forward in support of conscious free will that undermine the experimental framework, such as a subjective bias in timing external stimuli during cognitive experimentation [9,10] or the interpretation that these results represent a gradual development of conscious awareness [11]. In this essay, previous experimental results from investigations on decision making that purport a deterministic nature creates an illusionary free will are reinterpreted by revisiting seminal moments in the history of scientific discovery because the actual nature of time, a long-held foundation of physical assessment and scientific inquiry, has become a controversial topic [12]. This controversy has been named here the Time Paradigm Problem and it is a challenge the scientific community needs to come to terms with before any real distinction on the nature of decision-making can be made.

The time paradigm problem

The modern controversy around the time paradigm problem is an abstraction that arises out of Albert Einstein's concepts on the electromagnetic field, the constant speed of light and the movement of charged particles in 4-dimensional space-time [13], later called the theory of special relativity. As a consequence of Einstein's relative space-time, a notion of inclusive space-time arose in which the universe contained a complete gambit of time, including the past, present and future (a block universe), where time can be symmetrically represented in the mathematics [14,15]. However, life and experiment unfold in a uniform manner that seems to progress in accordance to an arrow of time, from past to future, as part of a space-time continuum [14] and all events are notably "relative" to one another, i.e. an event from the past is considered observed at a future moment by a living organism or an automated apparatus.

This controversy has grown consequentially with the realization that quantum aspects of nature are not classically defined [16-19]. In the 1940's, Richard Feynman utilized a "unification" of time and charge in formulating his famous diagrams (Figure 1A) [20] to deal with the Heisenberg uncertainty principle [21], wave/particle duality [16,17] and the necessity of quantum mechanical probabilities to predict quantum events [22]. These diagrams found success in the development of quantum chromodynamic and electroweak theories explaining the strong [23,24] and weak nuclear [25-27] forces, respectively. However, to account for the arrow of time in quantum mechanics, a concept of time symmetry breaking was introduced against mathematical symmetry [17,27] and has since become convention rather than considering a universe inclusive of the past, present and future.

This convention, however, may be more akin to the perceptual nature of observation and the definition of the observational reference frame than the reality of nature's time. The abstraction of time is a challenge that the scientific method has not been able to fully address because the nature of time remains hidden behind the veil of quantum phenomenon [16] and the uncertainty principle [21]. Interestingly, albeit not scientifically established, the "unification" of time and charge by Feynman appears similar to the expansion of 3-dimensional space to a 4-dimensional space-time that Einstein used when considering the movement of charged bodies [13]. This comment asks, was there something about charge that inspired Einstein to incorporate time into the mathematical framework? In retrospect, Einstein was working from a framework of James Maxwell's electromagnetic theories [28], the existence of charged particles (electrons [29] and protons [30]) and the Michelson-Morley experiment demonstrating the constant speed of light [31] when he had some insight into the photoelectric effect [32], the relativity of space-time [13] and the energy-mass equivalence principle [33]. In 1905, the year of Einstein's scientific revolution, the discoveries of the atomic structure [34], neutron [35] and positron (later considered anti- matter) [36] were things of the future. As such, it can only be guessed at what Einstein would have thought about the "unification" of time and charge if he had seen both the mathematical theory and physical experimentation of the last half of the 20th century until now.

Analysis

A physics perspective

In any regard, the "unification" of time and charge has been either unrealized, ignored, disagreed upon or altogether rejected by the mainstream scientific community leading to the present-day controversy [12]. The argument against this "unification" is as follows: In a universe where material objects move in both directions of time, objects would be expected to appear spontaneously without predestination, but since these events have never been observed, then time and charge unity is not a correct feature of nature [17]. The consequence of this argument has been the aforementioned notion of symmetry breaking, with respect to time and charge, in quantum mechanical descriptions of nature [27] to account for the apparent time paradox arising from the many interpretations of quantum mechanics [20-27] and the observational and experiential arrow of time [14,15]. The foundational aspect of experiential consequence and the convention towards time symmetry breaking as a real description of nature has outweighed the mathematical basis to view nature, in respect to both time and charge, as symmetrically whole.

A neuroscience perspective

A counter argument against a uniform arrow of time has been proposed in neuroscience that time-charge symmetry may be the underpinnings of the imagination and a mechanism for the brain to conceptualize events of the future because spontaneous events do occur in the brain as a form of insight [37]. This hypothesis is akin to Feynman's theory of the positron, which was considered to travel backwards in time [20].

However, the groupings of matter and anti-matter were reclassified to reflect charge orientation (i.e. matter: protons, positrons; anti-matter: anti-protons, electrons) rather than the order in which particles were originally discovered [29,30,35,36]. It postulates that the uniform arrow of time experienced is constituted by the nuclei of atoms within the body, brain and the external universe as denoted by their positive charge, where the bonding electrons move anti-directionally through time by travelling between and around the physical forms of nature that observation is based upon (Figure 1B). This is to say that electrons within a molecule at time A may not be the same subset of electrons within the same molecule at time B. To date, there have been no means to support or refute this interpretation of anti-directional time propagation of charge due to the observational dependency of quantum phenomenon [16,21]. Nonetheless, the subjective expectation that mathematical symmetry, in general and with respect to time and charge, holds in descriptions of nature (both physically and psychically) makes the time paradigm problem a quintessential question of contemporary physics and neuroscience. While the neuroscientific counter argument presented only adds to the current scientific controversy, the only rationale to accept the convention that all particles in nature move through time as a uniform arrow, rather than as directed by charge-time symmetry, appears to be personal choice.

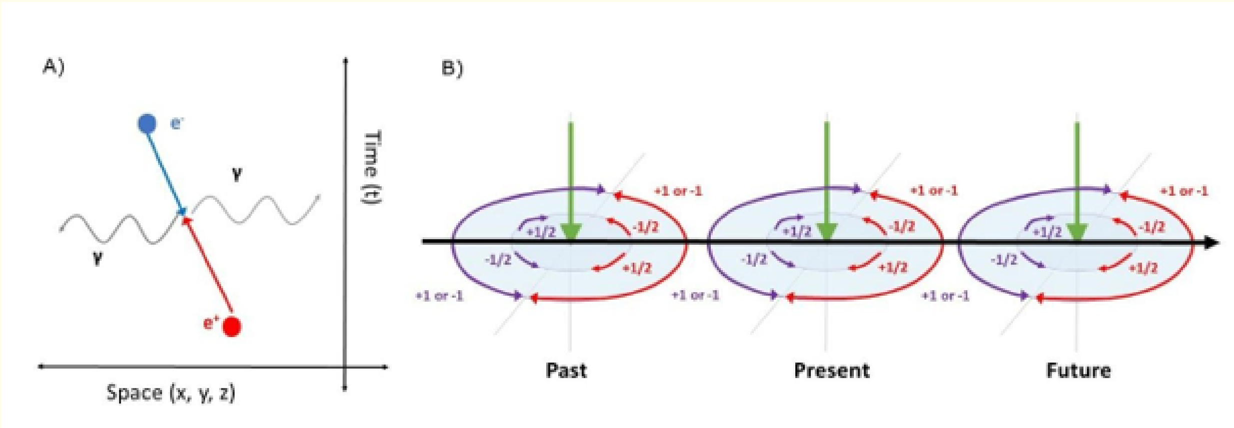

Figure 1: *The anti-directional time propagation of charge. A) Feynman diagram of positron-electron annihilation producing entangled photons. The oppositely charged leptons are depicted to transverse time in opposite directions. B) A diagram of three sequential events (past, present, and future) as represented by a 3-dimensional interpretation of $E=mc^2$ with a symmetrical electromagnetic (blue)/positromagnetic (red) plane of propagating waves and the potential magnetic spin values of photons (+1 or -1), electrons (blue) and positrons (red) (+ ½ or – ½). Green arrows indicate mass. The large black arrow depicts the experiential arrow of time.*

Discussion

When the neuroscience community, on the shoulders of Libet's work [1-8], accepted a deterministic view of nature, it overlooked another important aspect of the mind in addition to the time paradigm problem. That aspect is related to the unknown composition of the mind. While mainstream neuroscientists accept the mind to be a construct of the brain's neuronal circuitry, and there is plenty of correlation evidence to support this view [38-42], the mental representation of the brain may not be limited to a Newtonian cause and effect-type framework. First, the neurobiology of the brain evolved in a universe that appears to be relativistic and filled with quantum phenomenon. Second, the relationship between the mind and brain maybe more akin to a dualistic relationship between energy and matter. It has been postulated that the anti-manic effect of the pharmacological agent lithium, an ion that affects both physical and psychical biological factors, works by directly inhibiting the synthesis of ATP, the biological energy carrier [43]. This postulation is supported by direct kinetic evaluation of purified ATP synthase from chloroplasts [44] and aligns with Rene Descartes' postulation in the 17th century that the mind and brain are two separate entities [45,46]. However, it may not be sufficient to simply view the mind and brain as a dualistic separation of energy and matter because energy and matter may be interchangeable [33,37,47]. Nonetheless, there is scholarly impetus to think philosophically about the interrelationship between mind/brain and energy/matter, especially when contemplating the distinction between a deterministic nature and the freedom to choose.

In consideration of these significant unknowns, it may be more prudent to view Libet's and other's results [1-3,6-8] as an artifact of the experimental design, where the mind (whatever substance) makes a decision to act, then charged particles of the brain (electrons or protons and atomic nuclei) move in opposite time directions with electrons engaging the brain prior to the reported decision, thereby appearing as the brain activating before conscious decision-making in the experiments (Figure 2), than to draw a conclusion that free will is an illusion of biology [1-8]. In either case, it is certainly premature for the scientific method to make a valid assessment of the nature of decision-making. Considerably more discussion and insight are needed to illuminate the time paradigm problem so that its implications in nature can be realized.

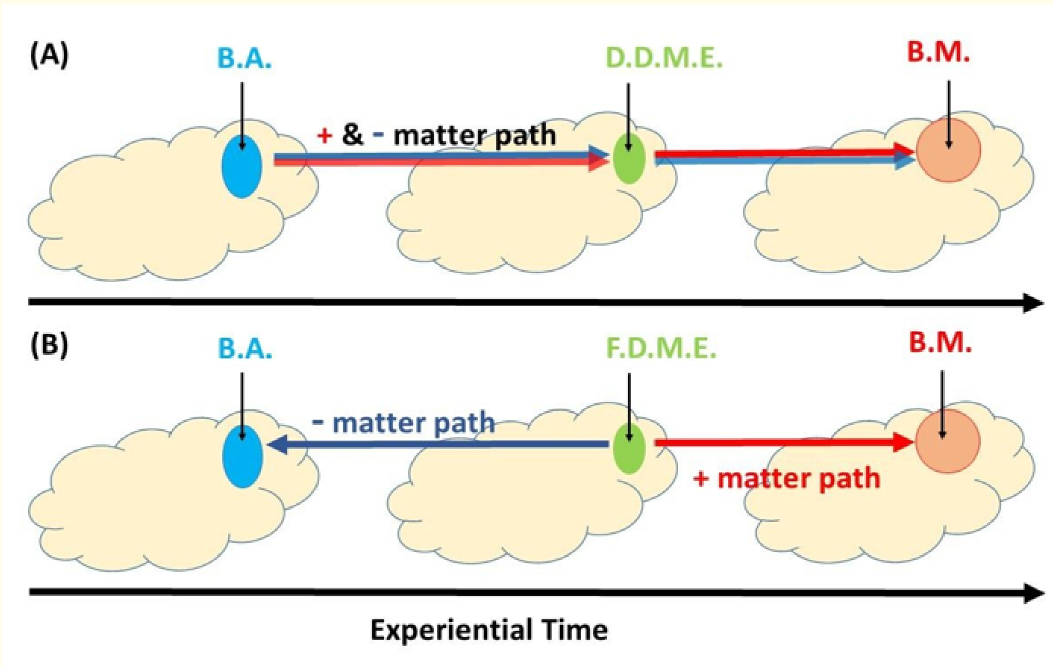

Figure 2: *Schematic interpretations of decision-making results. A) Conventional interpretation of decision-making experimental results in a uniform arrow of time. Brain activity (B.A.) has been observed to occur before conscious awareness of decisions to complete a body movement (B.M). This interpretation suggests that the conscious awareness of decisions represents a determined decision- making event (D.D.M.E.). B) Novel interpretation of decision-making experimental results in a non- uniform arrow of time. This interpretation suggests that the B.A. recording prior to conscious awareness of decisions may be due to anti-directional propagation of charge through time created by a free decision- making event (F.D.M.E.). Blue ovals represent brain activity; green ovals represent conscious awareness of decision; and red circles represent the resulting body movement. Black arrows represent the experiential arrow of time. Red and blue arrows represent the respective paths of charged entities in time (Red: positive charge; Blue: negative charge).*

Conclusion

The time paradigm problem has potentially vast implications on the interpretation and meaning of modern experimental results, especially in the fields of neuroscience, neurology, psychiatry and psychology. Better understanding of modern physics within these fields will open new avenues of research, both within medicine (i.e. development of future treatments) and in philosophy (i.e. contemplating determinism vs. free will).

Bibliography

1. Libet B., *et al.* "Readiness-potentials preceding unrestricted "spontaneous" vs. pre-planned voluntary acts". *Electroencephalography and Clinical Neurophysiology* 54 (1982): 322-335.

2. Libet B., *et al.* "Time of conscious intention to act in relation to onset of cerebral activities (readiness-potential); the unconscious initiation of a freely voluntary act". *Brain* 106 (1983): 623-642.

3. Libet B. "Unconscious cerebral initiative and the role of conscious will in voluntary action". *The Behavioural and Brain Sciences* 8 (1985): 529-566.

4. Expert commentaries on Libet B. "Unconscious cerebral initiative and the role of conscious will in voluntary action". *The Behavioural and Brain Sciences* 8 (1985): 529-566.

5. Smith K. "Neuroscience vs Philosophy: Taking aim at free will". *Nature* 477 (2011): 23-25.

6. Soon CS., *et al.* "Unconscious determinants of free decisions in human brains". *Nature Neuroscience* 11 (2008): 543-545.

7. Bode S., *et al.* "Tracking the unconscious generation of free decisions using ultra-high field Fmri". *PLoS One* 6.6 (2011): e21612.

8. Fried I., *et al.* "Internally generated preactivation of single neurons in human medial frontal cortex predicts volition". *Neuron* 69 (2011): 548-562.

9. Joordens S., *et al.* "When timing the mind one should also mind the timing: biases in the measurement of voluntary actions". *Consciousness and Cognition* 11.2 (2002): 231-240.

10. Danguah AN., *et al.* "Biases in the subjective timing of perceptual events: Libet., et al. Revisited". *Consciousness and Cognition* 17.3 (2008): 616-627.

11. Miller J and Schwarz W. "Brain signals do not demonstrate unconscious decision making: an interpretation based on graded conscious awareness". *Consciousness and Cognition* 24 (2014): 12-21.

12. Falk D. "A debate over the physics of time". *Quanta Magazine* (2016).

13. Einstein A. "On the electrodynamics of moving bodies". *Annalen der Physik* 322.10 (1905): 891-921.

14. Ellis GRF. "The arrow of time and the nature of spacetime". *Studies in History and Philosophy of Modern Physics* 44 (2014): 242-262.

15. Ellis GRF. "The evolving block universe and the meshing of times" (2016).

16. Merli PG., *et al.* "Electron interferometry with the Elmiskop 101 electron microscope". *Journal of Physics E: Scientific Instruments* 7 (1974): 729-732.

17. Penrose R. "The road to reality: A complete guide to the laws of the universe". Jonathan Cape, London (2004).

18. Yan H., *et al.* "Experimental observation of simultaneous wave and particle behavior in a narrowband single-photon wave packet". *Physical Review A* 91 (2015): 042132.

19. Vaccaro JA. "The quantum theory of time, the block universe, and human experience". *Philosophical Transactions of the Royal Society A* 376 (2018): 20170316.

20. Feynman RF. "The theory of positrons". *Physics Reviews* 76.6 (1949): 749.

21. Heisenberg W. "The Physical Principles of the Quantum Theory". University of Chicago Press, Chicago (1930).

22. Feynman RP. "Space-time approach to non-relativistic quantum mechanics". *Reviews of Modern Physics* 20 (1948): 367.

23. Gross DJ and Wilczek F. "Ultraviolet behavior of non-abelian gauge theories". *Physical Review Letters* 30.26 (1973): 1343-1346.

24. Politzer HD. "Reliable perturbative results for strong interactions". *Physical Review Letters* 30.26 (1973): 1346-1349.

25. Glashow S. "The renormalizability of vector meson interactions". *Nuclear Physics* 10 (1959): 107.

26. Salam A and Ward JC. "Weak and electromagnetic interaction". *Nuovo Cimento* 11 (1959): 568.

27. Weinberg S. "A model of leptons". *Physics Review Letters* 19 (1967): 1264-1266.

28. Einstein A. "Maxwell's Influence On The Evolution Of The Idea Of Physical Reality. James Clerk Maxwell: A Commemoration Volume". Cambridge University Press (1931).

29. Moore CE., *et al.* "The Proton". *Journal of Chemical Education* 62.10 (1985): 859-860.

30. Thomson JJ. "Cathode Rays". *Philosophical Magazine* 5.44 (1897): 293.

31. Michelson AA and Morley EW. "On the Relative Motion of the Earth and the Luminiferous Ether". *American Journal of Science* 34 (1887): 333-345.

32. Einstein A. "Concerning an heuristic point of view toward the emission and transformation of light". *Annalen der Physik* 17 (1905): 132-148.

33. Einstein A. "Does the inertia of a body depend upon its energy content?" *Annalen der Physik* 18 (1905): 639-641.

34. Rutherford E. "The scattering of alpha and beta particles by matter and the structure of the atom". *Philosophical Magazine* 21 (1911): 669-688.

35. Chadwick J. "Possible Existence of a Neutron". *Nature* 129 (1932): 312.

36. Anderson CD. "The Positive Electron". *Physical Review* 43.6 (1933): 491-494.

37. Rizak JD. "The plausibility of neutron biological interactions". *International Conference of Heart and Brain, Paris, France* (2016). Online at biorxiv.com

38. Davidson RJ., *et al.* "Regional brain function, emotion and disorders of emotion". *Current Opinion in Neurobiology* 9.2 (1999): 228-234.

39. Johnson MH. "Functional brain development in humans". *Nature Reviews Neuroscience* 2 (2001): 475-483.

40. Goldman-Rakic. "Development of cortical circuitry and cognitive function". *Child Development* 58.3 (1987): 601-622.

41. Bullmore E and Sporns O. "Complex brain networks: graph theoretical analysis of structural and functional systems". *Nature Reviews Neuroscience* 10 (2009): 186-198.

42. Zimmermann J., *et al.* "Unique mapping of Structural and Functional Connectivity on Cognition". *Journal of Neuroscience* 38.45 (2018): 9658-9667.

43. Rizak JD. "The inhibition of ATP production by lithium: A preliminary study in whole mitochondria extracted from rat brain and a putative model for bipolar disorder". *Annals of Psychiatry and Mental Health* 2.3 (2014): 1014.

44. Chen MF., *et al.* "Concentration gradient effects of sodium and lithium and deuterium isotope effects on the activities of H+-ATP synthase from chloroplasts". *Biophysics Journal* 96 (2009): 2479-2489.

45. Russell B. "A History of Western Philosophy". Simon and Schuster, New York, U.S.A (1945).

46. Mehta N. "Mind-body dualism: A critique from a health perspective". *Mens Sana Monographs* 9.1 (2011): 202-209.

47. Guilbaud S. "Can we make matter appear from emptiness?" *Recherche* 561.562 (2020): 60-61.

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