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Mathematics and Physics; Brain and Universe machine languages

Abstract

Revelations of the nature of existence, through humans' cognitive systems, have been evolving since the development of language. Part of such revelations, appearing early in the history of civilization, were geometrical forms and numbers, whose beauty and order, both wondrous and mysterious, conveyed a sense of unreality beyond the physical reality normally discerned; and to Plato, these were indications of the "other reality" of which only a few glimpses had occurred. Access to all the attributes of this reality required breaking out of the shackles of (mental) captivity; beautifully portrayed in Plato's cave allegory. The present era's sense of wonder about the effectiveness of mathematics in formulating the discoveries of the fundamental and natural laws of existence, on the one hand, and advances in computation, especially in artificial intelligence (AI), on the other have revived the Platonic idea, in one form or other. This revival is supported by some ardent adherents among the very minds who have contributed to furthering our understanding of the physical universe. The work presented here is an attempt to prove that a "physical world" precludes the prospects for "mathematics" to be its "other reality." This end is achieved by bringing to light the processes involved in the perceptions and discernment of the world by humans and, for that matter, by any creature with a physical central nervous system. The process involved makes it clear that the phenomena of the "physical universe" are played out (one way or other) in our "physical brains" as electrochemical operations, which are (fundamentally) physics-based computations. Therefore, the historically configured "symbolic language of mathematics" is the physical brain's "machine language" for the specific outputted expressions (formalisms) of the underlying physics of some of the (physically) sensed phenomena behind such computations. This rapidly developing language, much of it emerging in "appearances" foreign to the physical reality, has been taken by many great minds, including Plato, Galileo, Kant, and Wigner, as an indication of an incontrovertible mysterious mathematical world, or its language. However, it is inadvertently the "machine language" whose progress is owed to the successful efforts of the "computational brains" that are blazing the trail for discoveries of more novelties in the physics of the physical universe. The overall claim in this work is based on the ideas that (1) brains only sense the world physically and operate physically, and (2) mathematics has been known on occasion to be predictive of physics, and the latter of new frontiers in the former.

Keywords: Reality; physical; mathematical; computational brain; machine language

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Background

Mathematics, as many in the philosophical and scientific communities have believed, "is the language in which the fundamental laws of physics and nature are written.[1] Of course, mathematics in its own right has flourished in its many generally abstract fields, some of which may hold the key to advancing our understanding of the reality of our existence. This possibility is based on past developments in areas such as group theory, topology, symmetry, and complexity mathematics, which have proved instrumental in the revelation of the fundamental principles of physics. And physics is to further benefit from mathematics, such as the Poincare conjecture,[2] as well as other seemingly abstract findings, as gains are being made over issues such as the absence of apparent applicability and the difficult communicability or unfamiliarity of certain ideas. However, Plato more than two millennia ago, place mathematics on highest pedestal by calling it the "other reality," hinted upon in his cave allegory. Other proclamations by great minds of past centuries, including the likes of Galileo and Kant, point to the effect that "the essences of existence (are written in the language of mathematics," and mathematics' proven effectiveness is in its applications to different fields, specifically in physics, which may be regarded as mysterious.[3] Together, these ideas have promoted the view held by a number of scientists that perhaps "existence" altogether has a mathematical nature. The outspoken scientist Max Tegmark.[4] puts it this way: "… our physical world not only is described by mathematics, but that is mathematics." This idea has been masterfully explored in Tegmark's book,[4] where he deploys the up-to-date scientific understanding of matter (referencing the Theories of Relativity, Quantum Field Theory, and the Standard Particle Model) that only capable minds like his could harness. The beauty of the geometrical forms of physics (both old and mathematically generated) and his explanation of physical phenomena as mathematical patterns makes this idea very appealing. Certainly, as difficult matters such as the nature of consciousness[5] and all that is related to the matters of living become more scientifically addressable, it will become harder not to contemplate the possibility of this beautiful idea. However, since the premise mainly draws upon the presumption of mathematics as (anthropocentrically) the language of nature; but this not being the case, as will be shown, preempts the idea altogether.

Another mathematical and more tangible idea of the "other reality" is the hypothesis of existence as a "virtual reality," put forward by Nick Bostrom.[6] This hypothesis upends the idea of the illusory world that persists today, which has also been pondered by thinkers of past ages; here is a poem from the philosopher, mathematician, and poet Omar Khayyam that speaks to this idea:

For in and out, above, about, below,

'Tis nothing but a magic Shadow-show

Play'd in a Box whose Candle is the Sun

Round which we Phantom Figures come and go.

Obviously, the idea of everything being a simulation is more logical, beautiful, and thought-provoking than the idea of all being illusory, despite the latter seeming to be "a rose by any other name." Of course, embedded in this idea is the known fact that existence, whether virtual or not, is in the final analysis of the brain's simulation. In other words, simulation is thus a brain capability to which "dreams" bear solid evidence. It is important to observe that the brain-simulated worlds of "physical beings"—regardless of the possibility of the "other reality"-must correspond to some measure of the realities of the "physical world" that they inhibit due to the dictum of the Darwinist survival principle.

The concept of virtual existence is by no means far-fetched, and one can envision its possibility given recent advances in computations, and particularly in the development of human-like intelligence, the foreseeable creation of primitive robotic consciousness, and the very realistic simulations in computer games and virtual reality applications. Therefore, if and when the technological progress in our civilizations, or those of other possible civilizations, reaches certain heights-avoiding likely extinction on various accounts—the creation of a virtual reality becomes conceivable. Furthermore, its virtual occupants, with some measure of consciousness, could conduct seemingly realistic lives, the nature of which may also raise certain metaphysical questions. Given the possibility of a more advanced civilization having developed such capabilities, there is likelihood that our "other reality" could be a "virtual reality." Therefore, considering that our technological progress in the future may give us the ability to create a virtual reality, it is also conceivable that our creator may have been a virtual creature herself. However, this makes it apparent that regardless of how many generations of virtual existence there may be down the line, the need for a physical creator arises unless the first virtual creator happens to be Aristotle's God. While this last proposition is hard to accord with, we need to accept that the presence of at least one "physical reality" is a necessity from the perspective of this hypothesis.

The Thesis

While both ideas of the mathematical and virtual reality discussed above, rely on the existence of a "physical world," they still portray a sense of uncertainty about the ultimate reality of our own existence. Either it is a virtual creation of a sophisticated technology, or inherently mathematical (in its forms, patterns, and constructs). These are the possibilities that may loom in our minds. However, regarding the virtual reality hypothesis, matters of biological evolution and the cultural, social, and historical processes involved in the creation of the "virtual reality," all seemingly insurmountable, make the likelihood of us having a physical existence much more plausible. Therefore, with ground-level certainty of the physicality of our world, we first need to find out how and in what form this reality reveals itself: it must have to do with how a truly physical being perceives and discerns her inner and outer environment and becomes aware of it as we are. This process involves the stimulation of the senses, rendering brain activities (operations), which result in the recreation of the stimuli (environment simulation); its final relay to the physiological interfaces of the body; and its conversion to thought, speech, and/or muscular-skeletal expressions. Regarding the nature of brain operations, it has been established by grand neuroscience research efforts that they are computational;[7s] indeed, this idea has been accepted at the highest levels of the sciences (e.g.,.[8]). As to how the brain computes, scientific neural network computing devices,[9] inspired by the brain structure and widely deployed in artificial intelligence (AI), have provided some clues: on the face of it, similar trial-and-error learning and memory development happen in both in brain and the neural nets. In the latter, the signal weights are the memory data. Therefore, when addressing the functional operation of the brain, it can perhaps be presumed that the central nervous system operates in the manner of neuronal network (parallel) computational machinery with distributed memory. This is a conjectured similarity, from a ground-level computational perspective, that can be somewhat strengthened by drawing upon Ockham's razor, the similitude principle,[10] and the fact that the brain and the (brain-inspired) scientific neural network both avoid the fundamental incommutability flaw inherent in axiomatic mathematics, which digital computations in scientific usage are afflicted with.[11] The following paragraph from D. R. Hofstadter[12] speaks to the above understanding of the brain's computations, however strong in its wider connotations:

For another way of modeling mental processes computationally, take the neural nets—as far from the theorem proving paradigm as one could imagine. Since the cells of the brain are wired together in certain patterns, and since one can imitate any such pattern in software—that is, in a "fixed set of directives—a calculating engine's power can be harnessed to imitate microscopic brain circuitry and behavior."

The computational operations of the brain arise from humans' constant exposure to varying issues of existence, the events and complexities thereof, mostly sublime, occurring during the conduct of their lives. Outside of internal physiological demands, these issues and problems generally relate to individuals' drives for survival at the time. However, the force and the material fields (8), as well as the flood of data in the universe, are likely to be partly behind the constant activation of the beings' central nervous system, with the brain, the lifelong "live" data processing (computational) machinery, at the helm. Regardless of details, complexities are sensed through the tactile sensations[13] of the five senses, which detect streaming energy pulses that stimulate the nerve's electrochemical signaling in response to their energy characteristics. Such signals, in totality and depending on how they make it through the hurdles of synapses to reach a neuron cell, determine the cells' measured participation in the grand complex scheme of the brain's computations, which is announced by an appropriate (electrochemical) signature down its Axon. This signature for each neuron is the result of the stochastic play out of the multitudes of afferent signals conditioned with the brain's distributed electrochemical substrate of memories, ongoing gene expressions, and existing knowledge patterns.

In traditional computers, the inputs of the program language syntax, down to the levels of the assembler language, stimulate pulsations of electrical activities (processing) on a substrate of accompanying electronic (chip hacked) knowledge, which result in infinite outputs of electric pulsations that are generally interpreted at the machine interfaces in symbolic languages—both machinery operations of the traditional computers and the brains are governed by physical laws! In the case of human brain computations, the outputs are the resolution of complexities in the form of numerous analog signals that appear at the body interfaces, some of which are meaningful due to the availability of means of expression, such as thought, spoken and written languages, and arts. Some have no meaning, and some are incomplete or developing in their meaning. The subjective part of consciousness and mathematics are of the two latter kinds: the former possibly suffers from the semantic problems of the spoken language; the latter is a developing language, and behind its progress is the gradual resolutions (revelations) of the ever posed complexities of the eventful phenomena of the physical universe. Developments of the language of mathematics—that is the transfiguration of brains' electrochemical signals into a proper syntax in which the beauty of the formalisms of the discovered laws of physics have taken life, as well as its other exposures, abstract or otherwise—is likely to have followed the manner of the development of as spoken language. Accordingly, it may be considered complementary along the pathway to perfecting a natural language. Whether spoken language is internal[14] or learned is a contentious topic among linguists, but regardless, the necessity of communication in time, over perhaps a few hundred millennia, must have played a significant role in shaping some of the complex resolution (electrochemical) signals into their present syntactical form.[5]

Emphatically, mathematics is a symbolic conversion of the output of the electrochemically resolved well posed problem of physical nature in certain brains; and its origin perhaps goes back to the time when human brains, engaged with some aspects of the physical universe, rendered results that baffled them, and some that facilitated their lives. The interpretations of these events of the brains had to await a proper language to evolve—a way of extensively formalizing the evolving thoughts (i.e., brain outputs) about some of the essences of existence and the laws governing them. This need, in the context of anthropocentrically appearing efforts, had a slow beginning until its takeoff a couple of 100 years ago, during which mathematics evolved to its present-day status. Mathematics, beyond that which has facilitated the formulation of physics discoveries, and the beauty they portray, in its formalism, is that of a rapidly evolving symbolic language, which, in semblance to the machine language of traditional computers, is a brain computer language that represents the results of the purely physics-based operations of the brain. In such a context, perhaps the spoken language can be comparatively called a higher-level language. The grand attempt at grounding mathematics in logic[15] despite its near failure,[11] still may speak to the similarity of the process of the development of the mathematics language to that of spoken language.

It is important to note that the physics-based operations of the brain (besides their task of homeostatic upkeep) are behind the mental efflorescence of ideas, concepts, discoveries, and creativities, which are displayed through various layouts of human physiological interfaces. Such are the results stimulation of senses because of exposures to various environmental contents and triggers: all are tactile energy inputs, whether they are modulated photons or derived from other methods of communication, and originating from the exchanges among the brains (of humans). Mathematics, from its very early appearances, has always had, and much more so now, findings that appeared independent of physical reality and indicative of a mysterious life of its own. As to the kinds of energy that trigger its evolvement, one cannot know, but in considering the physics-based operations of the brain, one can speculate that certain physics is behind it. Furthermore, evidence of math leading physics in the past and new physics findings leading math, such as super symmetry, are perhaps important indications.

What may have led to thoughts of mathematics being the "other reality" may have had its origin in the non-physical appearances of mathematical language, symbolic in various forms, with no indication of the nature of the under-the-hood operations of the brains that render it. The electronic operation of traditional computers is rather obvious; however, the brain's electrochemical operations hardly draw any attention in the context of seemingly at-will mental powers. Of course, this supposition, applying more to past ages, explains why the laws of mathematics have been believed to be the laws of the operations of the brain; the following quote from Kant[16] implies such a take:

Did the sensations of themselves, spontaneously and naturally, fall into a cluster and order, and so became perception? No…putting sense into sensation requires innate knowledge…and because they are a priori their laws, which are the laws of mathematics, are a priory, absolute and necessary.

Existence is a cavalcade of innately mysterious forms with energy substrates. According to Aristotle "Form is not merely shape but the shaping force," of which beings are a part. Brains are autonomously ever engaged in their demystification—computing them—as the senses relay their stimulations by the flood of streaming data in the environment. The result, depending on how meaningfully they jive with the resolution potential of the brain, could vary from nonsense to the "Aha" moments of symbolic language outcomes in mathematics findings, or any other symbolic representations. In essence, all well posed problems in discipline-trained brains with intentional appearances (or by nature, in the context of a brain's computational ability) achieve some sensible results, some of which have rendered the state of human civilization. Others are likely to disclose more of the complex reality of existence. This reality is that of a "physical one," the laws of which are revealed in mathematical language formalism; the machine language of the brain. Though beautiful, they certainly are not indicative of mathematics being the language of the universe, or its "other reality."

Conclusion

The ideas of the "other reality," being mathematical (as constructs and patterns) or virtual, as profound and thought-provoking as they are, remain beautiful philosophical speculations that need to be taken very seriously, as any important philosophical topic should. This work, while not rejecting the possibilities of virtual reality, has attempted to provide logical and closely fact-based arguments to prove that wherever physical laws rule, existence, as perceived by physical brains, is inevitably physical. Parts of the (converted) perceptions are the makings of the language of mathematics, in its likeness to the assembler language in digital computers. And mathematics, the machine language of the brains, is the interpretation of the play outs (one way or the other) of some of the physics phenomena of the universe we inhibit in our brains.

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Conflicts of interest

The authors declare no conflicts of interest.

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