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INTERDISCIPLINARY INSIGHTS ABOUT THE CONCEPT OF TIME

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Abstract:

It has been suggested by some authors that time has no physical existence, but it would be an illusion. The human being uses clocks for measuring the numerical sequential order of the duration of material changes, namely the motion which runs in space. We experience a run of changes in the frame of the linear psychological time "past-present-future", which has its basis in the neurological activity of the brain. We could link it with a concept of universe where there is neither physical past nor physical future. In this model of "time-free" space (in the physical sense) it exists only what we observe with our senses and measure with apparatuses.

Key Words: Time; Physics; Neuroscience; Brain; Philosophy of Science; Interdisciplinary Science.

1. Introduction:

Some authors suggested the idea that time is an illusion [1-3]. We use clocks for measuring it; through clocks we measure the duration of the material changes, namely the motion running in the space in which we are. The suggested viewpoints seem to be extreme, and it seems to be controversial also the belief that the motion happens in some physical time.

The idea that time could have no physical existence, that the human being measures relations between different physical changes running in a time-free space, and that gravity may be encoded in a timeless configuration are considered as mainstream topics of physics [4-7].

We could consider a third option, which is in agreement with experimental data, namely that time is the *sequential numerical order of events* running in the space. We can use the name *fundamental time* for this kind of time. When an observer measures the fundamental time, it is transformed into duration and we can talk about it as *emergent time*. There is no duration without the measurement of the observer [8-12]. We do not have to date experimental results firmly confirming that changes and motion run in some time understood as a "physical" dimension; they do not happen in some physical time, but only in space.

2. About the Fundamental and Emergent Time:

Modern physics studied the reality at extremely particular conditions, such as those relating to the possible birth of the universe through an initial Big Bang. In particle physics and cosmology, Planck units have been introduced as a set of measurement units, exclusively defined in terms of four universal physical constants, i.e. the speed of light in the vacuum c, the gravitational constant G, the reduced Planck constant $\hbar$ and the Boltzmann constant k_B. It is a system of natural units defined only by Nature's properties.

For an elementary object, like a photon, we can consider its traveled space as a sum of Planck lengths; every Planck distance $l_{iPlanck}$corresponds to a Planck time$t_{iPlanck}$. In this sense, the Planck time is the fundamental unit of its sequential motion. The object is moving in space and not in some physical time; in this way, time is considered as the epiphenomenon of the change.

We can call *fundamental time* this numerical sequential order of changes; the measure by an observer leads to the coming into existence of the duration, i.e. the *emergent time*; this last one does not appear without the measurement of the fundamental time.

In science, it is important the search for a structure, as emphasized also by philosophers of science and neuroscientists. This goal is based on the development of a mathematically precise treatment of the notion of structure, and on the idea to provide an axiomatic basis for the notions of space and time underpinning the various theories of physics [13].

3. On the Linear Time Sequence "Past - Present - Future" in the Brain:

It appears to be no overt experimental evidence that time is a physical quantity running in the universe. In order to clarify that, we have to focus on the experience of the change.

The human being perceives with senses the information about the change. The information is transformed into an electromagnetic signal and moves in the brain through nerves. There is a neuronal activity, which is continuously creating the psychological sensation of the linear time in the sequence "past-present-future". It seems to be confirmed by several researches that the animal and human experience of linear time has the origin in the neuronal activity of the brain [14-17].

This experience of the material change as motion in the frame of the psychological time brings us to see changes running in a physical time despite we currently are not sure about the existence of this last in the

universe (in the physical sense). Therefore, the linear time in the sequence "past-present-future" would be only in the brain.

Also Einstein was aware of the psychological time; he believed that past, present and future are "stubbornly persistent illusions", and that time has "no independent existence apart from the order of events by which we measure it" [18].

Recent research conducted on the medial pre-motor cortex (supplementary motor area [SMA]) of the human brain, in experiments using ultrahigh field 7-Tesla (7T) functional magnetic resonance imaging (fMRI), seems to confirm that the duration of a given event observed by people cannot be well estimated; the duration of a given motion seems to be defined by the neuronal activity of the visual cortex. When the functioning of visual cortex area is disturbed by a magnetic field, the experience of motion is also disturbed [19-22].

4. A Look to Space - Time and "Block Universe":

The idea of a possible *time-free space*(in the sense of some physical time) is a topic discussed in various ways over the years, already in relation to the Minkowski metric and its intuitive meaning compared to the nature of the human observation [23].

The Minkowski space-time provided support for a view of the universe as four-dimensional (4-D) structure existing as an entity. The ontological nature of time is linked to the "eternalism", a philosophical approach to the existence over time as equally real, contrary to the "presentism" and to the "growing block universe theory" of time [24]. In the "block universe" model, where the description of space-time is as an unchanging four-dimensional block, past and future are coexisting; there is no basis for singling out a present time which separates the past from the future because all times coexist with equal status [25,26].

This vision could be re-thought in the light of a (physical) *time-free* space; reflecting on the binomial "change - coming into existence", when the change "n + 1" enters in existence the change "n" is not more existing, and what actually exists in the universe is what the human being can observe with senses and measure with apparatuses, also in relation to a *two-way relation* of mathematical nature for connecting the dynamics of the universe with the models describing it. The human being experiences the increase of entropy and the act of physical changes through the linear psychological time "past-present-future" as linear time.

Humans experience the possible status of a time-free space as "Now". Also Einstein had spoken in this direction, saying that there is something essential about the Now which is outside the realm of science [27].

The neuroscience results about the linear time "past-present-future" as created by the neuronal activity of the brain seem to validate the Einstein's idea of the "Now" expressed in physics.

5. Conclusions:

According to a line of thought that is reflecting on the concept of time as a fundamental and emerging reality in the frame of a unified theory, we can consider it in the light of these two aspects.

We could re-think the space-time structure, fruitfully used starting from Einstein's special relativity up to the current unified theories (such as the superstring theory), in the light of a (physical) *time-free* space; time is what we measure with clocks, measuring the duration of the material changes, namely the motion running in a (physical) *time-free* space [28].

The human being experiences the flow of material changes in the frame of the linear psychological time "past-present-future", which seems to have its origin in the neuronal activity of the visual cortex.

Modern physics has overcome the notion of "clear separation" among objects, introducing the concept of "participant" in place of that of "observer"; the concept of mind-consciousness is increasingly present in the process of describing the world and searching for a unified "not purely material" theory with non-local features using fractal / holographic-like space-time geometries [29-33].

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