Letter to the Editor

Hitchcock's Universe without time is superposed Universe of space gradients

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In the special relativity born in 1905 by Albert Einstein the notion of absolute time was defeated and Minkowski was able to show that only the space-time as a single object can have place in the physical theories. However with the invention of quantum mechanics (QM) some physicists including Pauli have "found" that in QM the time is nothing but a parameter, and because of the lack of a self-adjoint time operator the time has not equal status with the space coordinates. This lead some philosophers to speculate that time is a computational artifact not existing in the Universe (HITCHCOCK, 2003). Further he quotes the fMRI studies of the "internal timekeeper" in brain to corroborate his conclusion. In the following paragraphs I will show that whether space or time exist in the Universe and how many space or time dimensions there are, must be solved by physical experiments and conclusions about that cannot be derived by the study of the subjective construction of space and time in the brain.

WANG & CHEN (2002) have shown in details that the Pauli's definition of time operator is erroneous in several respects and that the time and space can be treated on an equal footing. Because of text restriction the whole mathematical proof cannot be presented in few paragraphs but one of their results is that the correct time operator is canonical conjugate to i_0 rather than H_0, so the Pauli's theorem no longer holds. A second argument against the standard QM is that because of the von Neumann's theorem there is only one vacuum in QM and QM cannot predict certain SSB phenomena (ALFINITO ET AL., 2001). In QFT however the von Neumann's theorem is not valid and there are multiple vacua – fact that well matches the experiment. Also QFT is compatible with relativity since it is derived from the relativistic QM via procedure known as second quantization. Thus the standard QM is not the ultimate theory, as most philosophers think, and QFT or advanced string theories must be used when one wants to have better description of reality.

Now I would like to pose several questions to Hitchcock that seem hard to be answered. HITCHCOCK (2003) conjectured that both the "objective time" and the "brain constructed time" is computational artifact. He concludes that conscious systems construct time via reading "time labels" but what about the clinical cases with time agnosia then? Such patients have no feeling of time, nor can understand what time is, but they are otherwise conscious beings! Since

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they process conscious information why they cannot deduce what time is when for example they watch a moving object or causal relationships between objects? Also the brain cortex is host of our consciousness and seems that it constructs time via observation of the "internal for the brain clock" (neural firing by the neurons in the right putamen and the basal ganglia), which however is external for the cortex. Why the *brain cortex* does not use its *internal activity* as a Feynman clock as suggested by Hitchcock but *observes the activity of external structures* (the basal ganglia)? The idea of internal dynamics producing "feeling of time" is not original, and indeed is proposed by PENROSE (1989, 1994). The clinical observation of cases with time agnosia however invalidates such type of reasoning. The right answer to the posed questions is that *time is objective* and in its dynamical change the brain is always in a quantum of time (in the classical geometry this is a time point). Since the time is one-dimensional and we are in such "time points" we cannot use the naïve approach to take a ruler and measure directly the distance between two time points. What we do is measure systems undergoing repetitive changes and then compare the past time intervals. However *the change of the brain per se does not produce feeling of time!*

Now I would like to note something on the existence of space dimensions since HITCHCOCK (2001) believes in the ultimate reality of only 3 dimensions. Again I will argue that the constructed by the brain image of 3 dimensional space does not tell us much about the real space, so we must use physical experiments and physical theories in order to find out the number of space dimensions. Exactly as in the case of time agnosia there are cases in which certain brain cortical regions are damaged so there is deficit in space perception. No matter that the patient has some kind of mental image of the surrounding world he/she cannot perform even a simple task in 3D. Thus the medical data give no special status to *space and time perception*, and indeed persons could be well conscious and have other perceptions having no biological idea of what time and space are - take it literally, this is not epistemological stupidity, indeed they cannot order objects in space or comprehend their spatial or temporal organization (*space and time-blindness*). The spatial perception could be totally erased but because the observed object has some objective spatial organization, the space-structure is mapped into another conscious 'qualia'. That's why at some extent *circles*, etc. simple geometric objects are percepted but not in their geometrical meaning i.e. the person percepts the circle as a 'clock', or a 'wheel' etc. not as 'circle'. Also this does not imply that the patients see the images distorted - they cannot understand the geometric difference between normal clock and the distorted drawing they have made - because the conscious content of both clocks (distorted and not-distorted) is the same i.e. 'clock'. In the same way time can be totally 'washed out' (still saying 'yes this is moving', but having no idea of time sequence, or time ordering) because the external objects have no way to manifest the time directly (time is not observable). Of course *the lack of space and time perception will deteriorate the survival capability of these patients* and they will need special care.

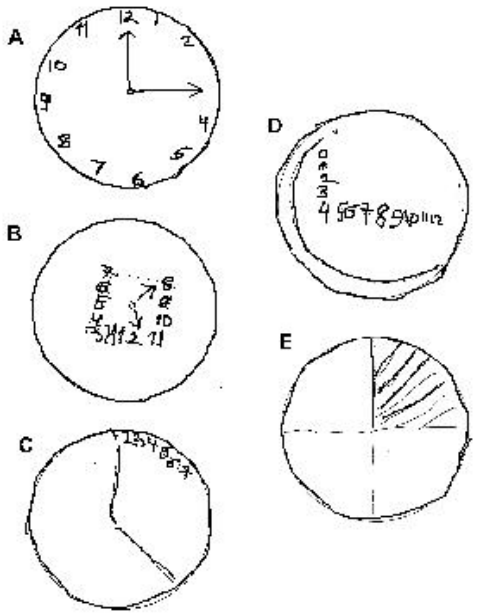

Figure I

Different patients are asked to draw a clock with all the numbers, and make the hands point to certain time, eg, 20 minutes before 2 o'clock. If their spatial orientation is disturbed or lost they produce strange figures.

Thus for our brain everything is constructed via "reading of informational labels" so for our consciousness both space and time are informational constructions. If we follow an extreme version of such approach we will come to the conclusion that everything around us is *computational artifact* of our brains and eventually come to a philosophical position called *idealism*, where exist only minds kept coherent by the God. So following Hitchcock's extreme reasoning we should accept that *space is computational artifact* too and his desire to accept the space dimensions as real, while the time dimension as artifact is hard to understand. The flow of information however suggests that *there must be something real* to produce the information. CHURCHLAND & CHURCHLAND (2002) defend the idea that the brain is like an informational map of the objective reality surrounding us. Only if there is something "objective" that can be mapped by our brain we can explain the evolution of consciousness via natural selection and can explain the adaptation of the organisms in Nature. Thus only if we accept both that our brain is like an *informational map* and that our brains have evolved by the *natural selection* for thousand hundreds of years we can be sure that the 4D space-time continuum is real.

What about the rest of dimensions in string theories then? The answer is that what we do not percept directly is not necessarily not-existing. Possibly we can perform experiments in the near future that can prove/disprove the string theories exactly in the way we can prove there are X-rays no matter that we don't see them with our eyes, which percept only narrow spectrum of the electromagnetic waves called *visible light*. Thus I think it is clear from the presented data that the study of conscious perception per se cannot tell us much about the surrounding world and that we study the conscious perception only in the framework of the mathematical and physical theories we already have.

Finally I will challenge directly the Hitchcock's proposal that the *change* is more fundamental than *time*. Indeed this is absolute nonsense because change and time mathematically are two different things. A measure for *change* is the *difference* e.g. $\Delta P=P_1-P_2$ which *is not zero*.

In contrast the *time* is *axis* and has geometrical meaning. HITCHCOCK (2001, 2003) insists the reader to imagine a kind of "pure change" with no time associated. Yes of course such exists e.g. the *gradient* of ions in a solution defined as P/x. In such situation there is *change* of concentration ΔP along distance Δx but there is no change in time! So unless the system is allowed to *evolve in time* no diffusion will take place. In similar manner if there is no time but only change in the state of a qubit this is well-known phenomenon called *superposition*. So evolution in no time produces superposition of states and no unique evolution of the quantum system exists.

Instead of conclusion I would advise Hitchcock to use strict mathematical definition of what he calls 'change' because science cannot be done from 'vague' intuitive ideas. The Hitchcock's timeless Universe will be nothing but a superposed image of space gradients! I even doubt that his definition of time as 'computational artifact' has any sense since it is not known how computation can be performed if explicitly is not defined arrow of time.

Acknowledgement

I would like to sincerely thank to MITCHELL J. PORTER (Highgate Hill, Queensland, Australia) for the thoughtful comments on the preliminary version of the letter.

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