OPINION AND PERSPECTIVES

Bergson's Intuition and Memory in View of NeuroQuantology

Erol Başar and Bahar Güntekin

Abstract

This essay describes the concept of great philosopher Henri Bergson, related to episodic memory, intuition and duration. Further, the relation of "quantum theory" to Bergson's philosophy is shortly described. We discuss the importance of Bergson's concepts to "Quantum Methodology" and modern science.

Key Words: Bergson, quantum theory, quantum methodology

NeuroQuantology 2009; 4: 602-608

1. The Importance of Bergson's Philosophy in the Era of New Physics and Contemporary Biology

In the 16th Century, Renee Descartes established the fundamental framework denoted as the "Cartesian System". Furthermore, Descartes introduced the concept of analytical geometry; with the help of this framework, physicists have established a strong theory of mechanics and later electromagnetics. Until the beginning of the 20th century, physical laws and engineering principles were based on the framework established by Descartes. Newtonian dynamics, which is the most important construct based on the principle of the Cartesian System, described a deterministic world.

At the beginning of 20th century, quantum theory and, later, quantum mechanics replaced the classical Newtonian view. Einstein's theory of relativity changed the idea of absolute time. Henri Bergson had a strong knowledge of physics and mathematics and was able to interpret Einstein's theory of relativity, although Einstein was not in agreement with Bergson's concept of relativity. Bergson has somewhat changed his interpretation and also has created ideas related to the indeterministic world.

Several authors (Stapp, 1987; Beauregard, 1987) have recognized that Bergson's interpretation of a new type of philosophy was, in essence, similar to Heisenberg's work on the S-Matrix. These thoughts and interpretations are described by Papanicolaou and Gunter (1987) in their book (chapters by Stapp, 1987 and Beauregard, 1987). Since Başar (1983) has argued that a possible interpretation of brain processes could be reached by Heisenberg's S-Matrix theory and later by Feynman diagrams, it is important to mention Bergson's work in relation to time and intuition.

Bergson's interpretation of Darwin's "theory of Evolution" is also relevant to some new models. We describe in the present paper the essence of the work of Henri Bergson on "time"

Corresponding author: Prof. Dr. Erol Başar
Address: Istanbul Kultur University, Brain Dynamics, Cognition and Complex Systems Research Center, Istanbul, Turkey
Phone: +90 212 498 43 92
Fax: +90 212 498 45 46
e-mail: e.basar@iku.edu.tr

and "intuition". This description is a prerequisite for understanding of the companion report by Başar and Güntekin (2009, in press), investigating new avenues on evolution theory, "intelligence" and also the electrophysiology of the brain.

According to the reasoning above, the aim of the present paper is to provide new perspectives on the core idea of Henri Bergson's "Duration (La dureé)" and the concept of "intuition". Further, this new perspective is pertinent to a new interpretation of Darwin's theory, as explained in the companion report. Bergson's philosophy was also a candidate to provide a bridge between Quantum Theory and the general framework of philosophy.

2. Essentials of Intuition

Intuition is the ability of human kind to perform creative methods of thinking and to apply these processes to produce inventions or new discoveries. This ability is a property of human beings and is not seen in the animal world. Cats, dogs and primates can display a relatively sophisticated level of intelligence and emotional behavior. However, they are not capable of making discoveries; they can not develop instrumentation, wheels or vehicles. In other words, they are not able to perform synthesis upon accumulation of their knowledge and facts from the environment. We understand this type of the superiority of the human brain as "intuition".

In order to further understand the processes of the dynamics of intuition, the next step will consist of identifying a way to measure the time of these dynamic intuitive processes. According to Bergson, the dimension of time in the process of intuition is not a real time; it is not measurable with conventional physical external clocks. The timescale of intuition is an internal time and is inhomogeneous. We further interpret that the time of the intuition is Bergson's concept of "Duration".

3. S-Matrix

Heisenberg (1943) pointed out that the full empirical dynamical content of relativistic quantum theory is contained in a certain function of momentum vectors called S-matrix. This quantity involves neither time nor its dual energy variable that distinguishes "before" from "after." In a recent publication, we discussed the importance of Heisenberg's S-Matrix and also the use of Feynman Diagrams (Başar, 1983; Başar, 1980; Başar and Güntekin, 2007; Başar, 2009) in brain research.

In classical theories of dynamics, the momentum distribution function is independent of the spatial distribution function. However, in quantum theory, all of the necessary information may be obtained from either of the two functions. Thus, one can represent the full mathematical content of quantum theory without explicitly referring to the special continuum, simply by expressing everything in terms of momentum variables (Schmidtke, 1987).

An important aspect of the S-matrix representation in quantum physics is that the equations that determine the S matrix can be expressed in terms of the S matrix alone, i.e., without reference to the continuous time variable, or its dual energy variable (Schmidtke, 1987).

The content of physics, as presented in the S matrix, is expressed in terms of inertial states and a "before and after" variable that accommodates discontinuous jumps between these inertial states. This conceptual framework appears to conform reasonably well to Bergson's concept of intuitions. According to this view, Başar (2009) proposed the use of "Feynman Diagrams" to present complex processes in the brain. This is proposed in the following way: The S-matrix consists of functions corresponding to the different possible combinations of initial and final systems. These are systems that, if left to themselves, would endure, unchanging, for all eternity. Each of these functions is a function of the momentum of each of the initial of final stable systems.

4. About Bergsonism: Material and memory and Creative Evolution

Several authors point out that Bergson's best known work is his 1907 book, "Creative Evolution", in which the concept of " vital force"

[2]is put forth to explain, why living beings are fundamentally different from inanimate matter. An idea with the goal of explaining evolution, the "Élan vital" first appeared in "Creative Evolution" (1907). Bergson portrays "Élan vital" is a kind of vital impetus, which explains evolution in a less mechanical and livelier manner, as well as accounting for the creative impulse of mankind. Further, Bergson states that the "superiority of human beings" to all other living beings is due to the intuition of the human brain. By using a terminology of non-linear systems, we may say that this is the most "important bifurcation" that occurred in nature to make the human mind "unique".

Jacques Monod (1971) commented that Bergson's poetry was not able to establish a durable theory. According to Deleuze (1966) there were no solid links between the different books of Bergson, which accounted for the declining influence of Bergsonism in the second half of the twentieth century. By reading the original text of Bergson's "Matter and Memory" (1896) and "Creative Evolution" (1907), it is possible to discover the existence of several leitmotivs in the work of Henri Bergson. In our opinion the existence of two types of memories, the concept of "duration" and the description of human intuition inspired by Darwin's theory on the evolution of species (1859) constitute a solid chain of ideas that were described in an era of research not undertaken with electronic instrumentation and diverse methods of analyzing anatomy and electrophysiology. We underline the following view: Had Bergson been able to draw upon the experiences of modern neurophysiology and theory of brain oscillations, he would certainly have been able to produce a much more profound description of "Creative Evolution". His idea to use the Darwinian concepts to analyze the "Creative Evolution" of the human brain was an inspired one, as we will explain in the accompanying paper (Başar and Güntekin, in press). The following text presents the essential ideas of Bergson related to the two types of memory.

Bergson described that if a perception occurs within a very short time it always needs certain duration and, as a consequence the effort of the memory: "Perception and memory are not separable". Our percepts mostly reflect images in our environment; the first component is the "sensation". However, the memory also embraces a realm of remembering linked to our immediate perception. A multiplicity of moments constitutes the essential core of our subjective perception. Bergson's "Matter and Memory" (1896) leads to distinguishing three types of memory components: The "pure memory", "the image memory" and "perception"; None of these components can occur separately. Perception is not characterized by simple contact of the mind with the present object. Rather, perception is embedded in the remembering of images that, in turn, participate to pure remembering.

We mention the views of Hayek (1952), Fuster (1995), Baddeley (1996), Desimone (1996) and Başar (2004). These authors strongly assume that perception and memory are inseparable. In other words, these authors support once more the unification of perception and memory first introduced by Bergson.

5. "What Is Time?" "What Is Duration?"

Does Bergson's concept provide a gateway to a transcendental philosophy and metaphysics of the brain?

In Figure 1 a schematic description of two different "Time positions" are illustrated:

1) Homogeneous time
2) Inhomogenous time

Homogenous time is the usual, "real time" measurement with physical clocks. In the inhomogeneous time, it is not possible to measure real time, because, during sleep and the process of episodic memory, the brain can condense time periods of many years within a fraction of second. Long episodes also occur within short periods of time in dreams.

[2] Elan vital

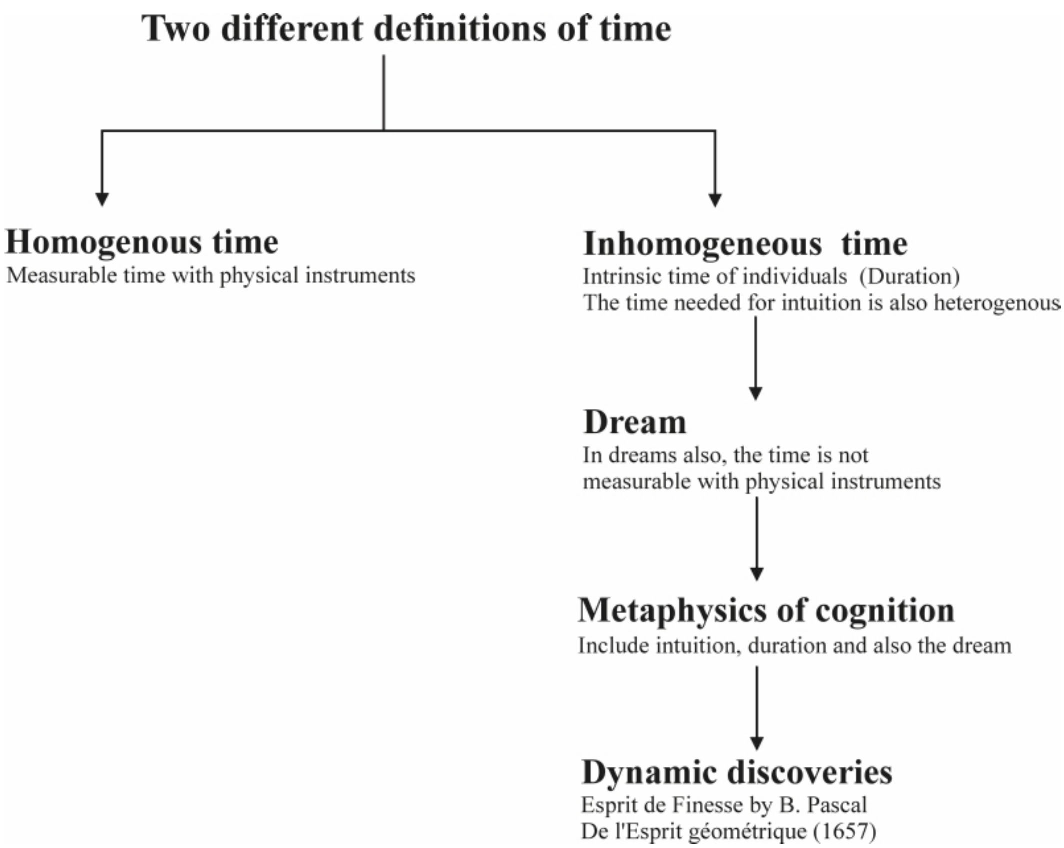

Figure 1. Two different definition of time

According to Deleuze (1966), Bergson commented that science seeks prediction and utilizes concepts and intellect in its methodology. Scientists need not claim that reality is deterministic in any metaphysical fashion in order to pursue their goals. Bergson recognizes, the utility of prediction in an intellectual order, but suggests that the vitality (élan) of life is understood better in terms of "duration" and with recognition of its fundamental unforsee-ability). Past-Present-Future are not three separate points or areas on a line; rather, for Bergson, the past real memory is flowing through consciousness; the present is continuous perception with its characteristic *durée*; and the future is the creation, newness and the unforeseeability of experience. *Durée*, thus, is best understood intuitively. We must be careful not to replace the uniqueness, continuity and flowing quality of our temporal experience with quantitative, objective, instants of time. "…as soon as one aspect of it (*durée*) is treated in isolation- and this happens almost inevitably when we begin to talk about it-such treatment tends to be misleading; we unconsciously confer the discontinuity of the discourse into the complex indivisibility of the referent." Deleuze (1966),

Is the duration of thought and Alpha correlated?

According to Bergson, "Reality" is changing; is continuous, it is heterogeneous and indivisible. Moreover, it is evolving and creative. We can understand this reality intuitively and thus grasp its dynamic, creative, changing character, or we can conceptualize it intellectually and deal with it objectively or quantitatively. Bergson's opinion is that science and metaphysics is a product of intuition. "A thoroughly intuitive philosophy would realize the much desired union of science and metaphysics." The following illustration is modified from Charles Schmidtke (1987) (Figure 2).

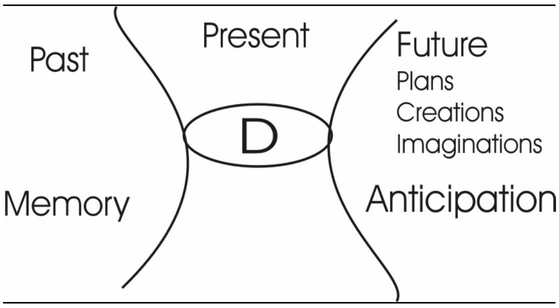

Figure 2. For the explanation see the text (modified from Charles Schmidtke; 1987)

In Figure 2, the past memory and the anticipation of the future is connected with the *"duration".* Further, the important feature of the diagram is that duration is the linking element between past and future. According to Schmidtke (1987), this means that, while we are a participating agent, we are involved in a continuous process of creating and retaining memories, as well as using and recalling memories. The meaningfulness of our memories requires that they remain within a context and remain "dynamic". To this consideration, we have to add two important remarks.

1) Our memory is not considered as a static function, stored somewhere in the brain and which is used when we try to remember the past. By our thinking, or during processes of creativity, the memory is interwoven with or embedded in the duration of the creativity. This means that the process of memory evolving is included in the duration and is a completely dynamic process.

2) The memory is acting and performs functions, since it is not separable from all other brain functions. "*Memory and Duration*" are interwoven Schmidtke (1987).

6. A New Interpretation of Intuition and Duration in Relation to Creative Processes

We will perform another step, which is somewhat different from Bergson's "intuition" and "duration" .The occurrence of an intuitive process our brains requires high speed access to past memories, meaning episodic and semantic memory. Further, the intuitive human brain must be able to transform events in the "episodic and semantic memory" to a type of intermediary virtual memory, which extends past events to some future projections. This may be explained using a simple example: We can recall the figure of our partner and imagine her/him wearing new clothes, which we have seen immediately beforehand, in a department store. According to Bergson this is pure imagination. Certainly, this is a very simple example, which is suitable to explain the core of the creative memory or the necessary way of thinking. In order to perform this process, in reality, we might possibly require several hours. However, this type of creative synthesis can be performed in a fraction of a second in our creative memory. According to our consideration, this is what duration means in the processes of discoveries in the creative mind (Figure 3).

A more complicated or difficult example would be the application of a mathematical equation to an observed phenomenon; an experimenter or mathematical scientist can foresee the results again in a very short time, non-measurable with external clocks (see Penrose, 1989). We point out here the famous story of Henri Poincarré, who proposed a mathematical solution (which he intuitively felt to be correct) to a difficult mechanical problem that could be solved later with a number of mathematical steps that certainly took longer time measurable with external clocks. At this point, we should make two comments: 1) Such an intuitive process is dynamic, in essence, non-linear dynamic. We say non-linear dynamic, since the time axis is inhomogeneous; possibly even a nebulous time axis, as described by Başar and Güntekin (2007).

2) The second remark is the importance of memory during the duration and occurrence of intuition. Without memory, it is impossible to transform the past memory to a creative memory (See Figure 2). If we accept the above chain of reasoning, it is easy to recognize that memory, duration and intuition are inseparable. This is similar to the space-time-matter continuum in physics. Our creative brain or thinking brain moves in a universe which consists of memories of real life and the virtual life, created upon the existence of memory. This universe is also not separable from our body.

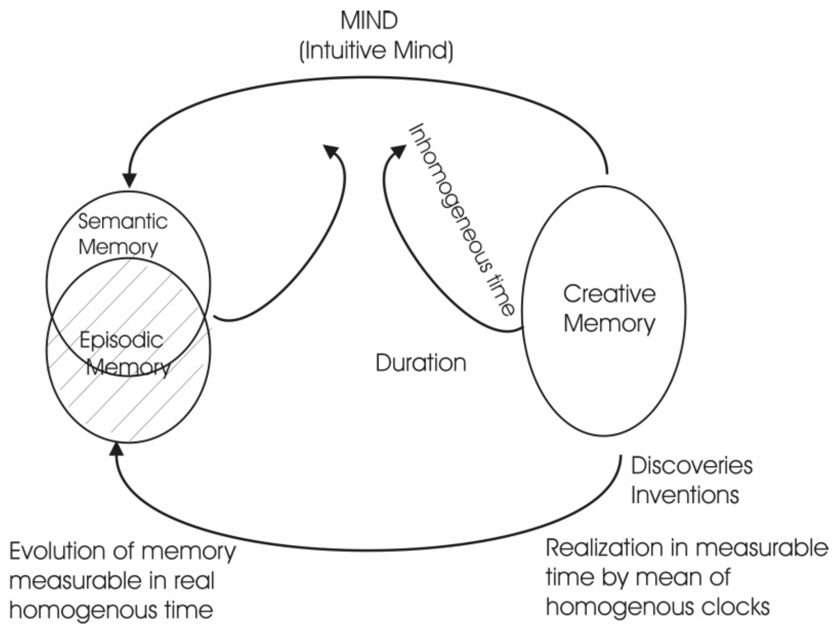

Figure 3. A schematically explanations of link between episodic memory, creative memory by means of "duration", for more detailed information see text.

This is also similar when we observe the processes of dreams. The time in dreams may virtually encompass years, hours or minutes, whereas the real time may be span only a few minutes (Figure 1). Is the ability of our brains to be aware of very long processes in short physical time measured by clocks in creative thinking? Do creative thinking and dreaming require similar inhomogeneous time? Is the "zipping of time" during creative evolution the basic property of the brain, or is the essential key to understanding metaphysics of the brain. The elapsed time during creative processes and during dreams may extend to years. Moreover, can we ask the question of whether this time evolution is a macro process of time expansion in Einsteinian trips to Galaxy?

7. Lessons from Bergsonism in Quantum-Brain

Why is the concept of Bergsonism important for a theory of brain-body-mind integration? There are several reasons of this:

A) In the companion report, we describe an electrophysiological synthesis on the creative evolution and Darwin's theory on the evolution of species. The contents and implication of that report is possibly the first step towards unifying a biological empirical theory (Darwinian evolution) and a philosophical interpretation of Darwinism together with new electrophysiological measurements that are useful to amalgamate these three items as a tentative step towards a new type of model. The establishment of such a concept required the synthesis of ideas from several fields of physics, particularly "thermodynamics". Whether this synthesis is a reliable may possibly be tested in future via experimental studies. Here, the lesson from Bergson is that a philosopher must develop or may develop a theory by closely analyzing empirical results. In developing the present paper, the authors studied the original text of Darwin's "*The Origin of Species*" and "*Evolution Creatirice*" by Bergson. The authors discussed electrophysiological parameters according to Bergson's question, "What is different in the brains of humans in comparison to other lower species?". Synchronization, amplitude and entropy of alpha activity were identified as relevant parameters for comparison. Further investigation indicated that human alpha activity is a potential candidate to explain the electrical behavior related to intuition. In order for philosophers to develop new theories and, accordingly, greater understanding or new discoveries, it is necessary to ask the appropriate initial questions. From the time of Descartes, Pascal, Hume and Locke, the world of science has witnessed great discoveries. However, at the beginning of the twentieth century almost no philosophers studied Darwin, James, Stuart Hill and Albert Einstein to ask new questions following major advances in scientific understanding. Following on from the path-breaking work of Bergson, we have an opportunity to perform more empirical analysis to further the understanding of the mind.

B) Bergson introduced the gateway to new definitions of memory and duration.
As stated in previous sections, the duration is a type of method explaining the inhomogeneous time. Inhomogeneous time is also interwoven with the essence of episodic memory. We do not yet have the means to measure inhomogeneous time. However, neither did Descartes, Pascal and Locke have the means of measuring thoughts or, as we say today, the cognitive processes. By asking the question of how to measure inhomogeneous time, the measurement of inhomogeneous time may, one day, become a possibility.

C) From the companion report by Başar and Güntekin (2009, in press) and the present paper, it should be evident that philosophy can serve as a means to understand processes in physics and biology. Carl Friedrich von Weizsäcker (1985) extended the classical causality principle to the modern probabilistic causality concept applied in quantum physics. Multiple causalities in brain-body-mind integration are also probabilistic in their nature. The theory of the probabilistic brain or quantum brain also derives from relevant philosophical questions. The question of whether the brain-body-mind integration can be better understood by means of the S-matrix or Feynman diagrams cannot yet be completely answered. If these problems can found relevant application in future, this will demonstrate the importance of the method of philosophy.

References

Baddeley A. The fractionation of working memory. Proc Natl Acad Sci USA 1996; 93: 13468-13472.
Başar E. EEG-Brain Dynamics. Relation Between EEG and Brain Evoked Potentials. Elsevier, Amsterdam 1980.
Başar E. Toward a physical approach to integrative physiology I. Brain dynamics and physical causality. American Journal of Physiology 1983; 14: 510–533.
Başar E. Memory and Brain Dynamics: Oscillations Integrating Attention, Perception, Learning and Remembering. CRC Pr, New York 2004.
Başar E. S-Matrix and Feynman Space-Time Diagrams to Quantum Brain Approach An Extended Proposal. NeuroQuantology 2009; 7-1: 30-45.
Başar E, Güntekin B. A breakthrough in neuroscience needs a “Nebulous Cartesian System” oscillations, quantumdynamics and chaos in the brain and vegetative system. Int J Psychophysiol 2007; 64: 108–122.
Başar E, Güntekin B. An essay on Darwin's theory and Bergson's creative evolution in the era of neuroquantology. NeuroQuantology 2009; 4: 609-622.
Beauregard OC. Bergson's Duration and Quantal Spacetime Non-Separability. In Papanicolaou AC, Gunter PAY (Eds.). Bergson and Modern Thought: Towards a Unified Science. Harwood Academic Publishers, New York 1987.
Bergson H. Matière et mémoire (Matter and memory). Macmillan, New York 1896.
Bergson H. L'évolution Créatrice. Presse Universitaires de France, Paris 1907.
Darwin C. The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. London 1859.
Deleuze G. Le Bergsonisme. PUF, Paris 1966. Trans. as Bergsonism, by Hugh Tomlinson and Barbara Habberjam. Zone Books, NY 1988.
Hayek FA. The Sensory Order. University of Chicago Press 1952.
Heisenberg W. Die "beobachtbaren GröЯen'' in der Theorie der Elementarteilchen (The "Observable Quantities" in the Theory of Elementary Particles). Z Phys 1943.
Desimone R. Neural mechanisms for visual memory and their role in attention. Proc Natl Acad Sci USA 1996; 26: 13494–13499.
Fuster JM. Memory in the cortex of the primate. Biol Res 1995; 28: 59-72.
Monod J. Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology. Alfred A. Knopf, New York 1971.
Papanicolaou AC, Gunter PAY (Eds.). Bergson and Modern Thought: Towards a Unified Science. Harwood Academic Publishers, New York 1987.
Penrose R. The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics. Oxford University Press, New York 1989.
Schmidtke CR. Bergson and a Pulsational-Wave Model of Temporality: A way to Disentangle Theories in Gerontology. In Papanicolaou AC, Gunter PAY (Eds.). Bergson and Modern Thought: Towards a Unified Science. Harwood Academic Publishers, New York 1987.
Stapp H. Bergson and the Unification of the Sciences. In Papanicolaou AC, Gunter PAY (Eds.). Bergson and Modern Thought: Towards a Unified Science. Harwood Academic Publishers, New York 1987.
Weizsäcker CF. Aufbau der Physik. Munich 1985.