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Opinion and Perspectives

Carl G. Jung's Synchronicity and Quantum Entanglement: Schrödinger's Cat 'Wanders' Between Chromosomes

Igor V. Limar

Abstract

One of the most prospective directions of study of C.G. Jung's synchronicity phenomenon is reviewed considering the latest achievements of modern science. The attention is focused mainly on the quantum entanglement and related phenomena – quantum coherence and quantum superposition. It is shown that the quantum non-locality capable of solving the Einstein-Podolsky-Rosen paradox represents one of the most adequate physical mechanisms in terms of conformity with the Jung's synchronicity hypothesis. An attempt is made on psychophysiological substantiation of synchronicity within the context of molecular biology. An original concept is proposed, stating that biological molecules involved in cell division during mitosis and meiosis, particularly DNA may be considered material carriers of consciousness. This assumption may be formulated on the basis of phenomenology of Jung's analytical psychology.

Key Words: consciousness, synchronicity, quantum entanglement, nucleic acids, mitosis, meiosis

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Problem formulation and related studies

To be sure, the concept of synchronicity represents an integral part of analytical psychology. Carl Jung believed, that synchronicity is closely related to numerous manifestations of psychic life of the humans, both normal and affected by pathology. Determining the nature of the phenomenon of synchronicity may become important for psychotherapeutic practice, particularly for difficult clinical cases which today cannot be subjected to psychological correction using methods of classical psychiatry. At the same time, we know that exotic nature of 'manifestations of synchronicity' caused to certain extent skeptical attitude by a number of researchers. Considering criticism of Jung's theory of synchronicity by his opponents, it should be, nevertheless, admitted that in doing his research the founder of analytical psychology was guided, in particular, by principles of contemporary theoretical physics. For instance, it is well known that Jung has developed the concept of synchronicity in close collaboration with Wolfgang Pauli. Thus, the Swiss psychologist has always made sure that the data gathered from his clinical observations conforms to the principles of natural science.

Still, specific mechanisms which, probably, lay at the core of synchronicity phenomena became a subject of discussion only in the early 1980s thanks to the progress in experimental studies of certain concepts of quantum physics. In one of the relatively early papers devoted to this matter (Keutzer, 1982), the synchronicity

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phenomenon was juxtaposed with the 'morphic resonance' hypothesis suggested by Rupert Sheldrake. In turn, the Sheldrake's theory is interpreted in the above study in the context of quantum non-locality, a consequence of solution of the so-called Einstein-Podolsky-Rosen paradox. In his later papers (Keutzer, 1984a; b), this author clearly associates quantum non-locality with Jung's synchronicity. Afterwards, other researchers (Mansfield and Spiegelman, 1989) have reviewed non-local quantum correlations, the Schrodinger's cat paradox, and experiments verifying Bell's inequalities in relation to the synchronicity phenomenon. The same researchers also reviewed the principle of superposition within the context of attempts to explain the synchronicity phenomenon (Mansfield and Spiegelman, 1991). Furthermore, Mansfield, reviewing Jung's theory, has analyzed, among other aspects, the role of Bell's inequalities per se in respect to the problems of analytical psychology (Mansfield, 1991). A similar paper (Germine, 1991) also dealing with the synchronicity phenomenon, the concept of quantum non-locality, and the Einstein-Podolsky-Rosen and Schrodinger's cat paradoxes, is devoted to determination of the nature of consciousness. Study of relation between quantum non-locality and Jung's synchronicity, and the matters concerning Bell's inequalities continued in later papers (Mansfield and Spiegelman, 1996).

Publications discussing, in one way or another, the synchronicity phenomenon in relation to the quantum entanglement phenomenon have appeared during the past decade (Walach, 1999; Walach and Römer, 2000; Duch, 2002; Milgrom, 2002; Primas, 2003; Stillfried and Walach, 2006; Teodorani, 2006). The latest papers in this sphere of study contain quite detailed research (Lucadou *et al.,* 2007; Carminati and Martin, 2008; Martin *et al.,* 2009; Martin *et al.,* 2010).

At the same time, it should be noted that attempts to explain the synchronicity phenomenon by considering other physical mechanisms not directly related to quantum non-locality (Zabrizkie, 1995) are quite scarce.

It should also be mentioned that some authors look at the quantum entanglement phenomenon in regard to other aspects of Jung's theory without linking this phenomenon directly to the synchronicity phenomenon (Blutner and Hochnadel, 2010; Conte *et al.,* 2010).

Nevertheless, even though the probable role of quantum non-locality in realization of synchronicity phenomena is clearly emphasized in the above papers, the question of what physiological mechanism might be responsible for the existence of quantum entanglement between different human bodies has not been considered so far. The only exceptions in this respect are, perhaps, the studies by Michael Hyland, who also believes that the synchronicity phenomenon is caused by quantum entanglement (Hyland, 2004a). The criterion enabling to consider that the mentioned corresponding physiological mechanism has been suggested is a description of necessary and sufficient conditions for occurrence of quantum entanglement between biological molecules of different people. Broadly speaking, these molecules may not be interconnected by quantum entanglement prior to mutual interaction. As quantum entanglement between biological molecules of different people may not exist per se, in the absence of once occurred special physical interaction, it is only this criterion that can be valid. We cannot generally assume that available quantum entanglement between molecules of different people is taken for granted. In one of his papers (Hyland, 2004b), Hyland made an assumption that quantum entanglement may exist both between cells of the same human body and between different subjects. Apparently, this author came very close to the solution of this problem in his another paper (Hyland, 2003a), where he not only assumes existence of quantum entanglement at DNA level within the same body, but also describes possible role of quantum entanglement in meiosis processes. It is quite possible that all that needs to be done is just one little step further – to expand this author's perception of existence of quantum entanglement at DNA level within the same body and its role in morphogenesis to the hypothesis of existence of quantum entanglement between DNAs of different bodies. As far as meiosis processes are concerned, Hyland regards the role of quantum entanglement exclusively as regulating the cell division. The fact that

meiosis may represent a mechanism ensuring quantum entanglement between different bodies was left out by this author. In the meantime, solution of the problem of existence of non-local quantum correlations between different bodies, in particular, synchronicity phenomena, could be right there. The answer to this question will be proposed in this paper below.

Study goal and hypothesis

Synchronicity phenomena have been studied for quite a while and not just by Jung but (a much lesser-known fact) by Sigmund Freud, the founder of psychoanalysis. His several papers corroborate this fact (Freud, 1922; 1953a; 1953b). Naturally, the famous Austrian psychiatrist used somewhat different terminology, but in the essence, he studied phenomena of the same nature. A telling fact: in the same period, scientific community gained understanding of the nature of quantum phenomena which later were associated with the synchronicity phenomenon. We are talking about the so-called Einstein-Podolsky-Rosen paradox, study of which helped postulate existence of quantum non-locality and quantum entanglement, closely related to non-local quantum correlations.

As we know, the quantum entanglement means a quantum-mechanical phenomenon in which quantum state of two or more objects should be described in interrelation with each other, even if individual objects are spaced apart. As a result, correlations appear between physical properties of these objects.

The quantum entanglement phenomenon is also viewed at in relation to such notions as quantum coherence and quantum superposition. The principle of superposition in quantum physics will be discussed further in connection with the Schrodinger's cat paradox.

Nevertheless, this branch of theoretical physics began experiencing rapid development only during the past few decades. It can be explained, first of all, by emerging possibilities for experimental verification of violation of the so-called Bell's inequalities. It is also important to note that quantum entanglement, as follows from definition and the nature of this phenomenon, represents the most 'functional' (comparing to other physical mechanisms) instrument as far as attempts to interpret Jung's synchronicity are concerned. Yet, it still remains unclear how exactly the quantum entanglement may exist at the level of material carrier of consciousness, i.e. brain, and how the quantum entanglement may ensure non-local correlations between different subjects which make synchronicity possible. Solution of this problem is the goal of the study this paper is devoted for.

Let's assume that correlation of mental processes in different people not exchanging any information among themselves, i.e. synchronicity, is caused by non-local quantum correlations (quantum entanglement) between certain parts of these people's brain (Persinger *et al.,* 2008). At this point, it needs to be noted that we can't talk about existence of quantum entanglement as such between macroscopic objects. The 'quantum entanglement' term is applicable exclusively to the objects of microworld, particularly at submolecular level: molecular orbitals (electron shells) of molecules, chromophore parts, etc. Therefore, it is, for example, correct to say 'quantum entanglement between neuron structures at submolecular level' instead of 'quantum entanglement between nerve cells', or make the following formulation: 'quantum entanglement between electron shells of neuron molecules of different people' instead of saying 'quantum entanglement between different people'. Also, as of today, direct observation of effects involving quantum entanglement at the level of macroscopic objects is highly questionable. Nevertheless, it should be noted in this respect that by this time, certain attempts were made at experimental observation of these phenomena as part of the quantum superposition studies (Gevaux, 2010; O'Connell *et al.,* 2010). And finally, it is important to emphasize that quantum entanglement cannot directly represent a mechanism of communicating information per se. Quantum entanglement may serve only as an instrument of ensuring correlation of certain physical quantities. In this case, correlation may be implemented at indefinitely large distances without limitation on speed imposed by the special theory of relativity.

Currently, existence of quantum coherence and quantum entanglement in biological molecules is intensively studied and is considered proved at experimental level (Gilmore and McKenzie, 2005; Plenio and Huelga, 2008; Thorwart *et al.,* 2009; Hossein-Nejad and Scholes, 2010; Sarovar *et al.,* 2010). Many researchers believe that quite specific problems in living organisms may be solved using quantum entanglement (Cai *et al.,* 2010). However, when studying the synchronicity phenomenon it is important to find out how quantum entanglement between biological structures of different organisms may occur. In this respect, let's assume that quantum entanglement between biological molecules may occur as a result of 'coherent resonance energy transfer' (Jang *et al.,* 2008; Olaya-Castro *et al.,* 2008; Collini and Sholes 2009; Nazir 2009; Kekovic *et al.,* 2010; Nalbach *et al.,* 2010; Sholes 2010). Some authors describe possibility of quantum entanglement occurring during electrostatic (Coulomb) interaction (Mishima *et al.,* 2004). Consequently, one may also assume that quantum entanglement between parts of biological molecules occurs as a result of the above interaction. Another physical mechanism by virtue of which quantum entanglement can arise is the Fermi resonance (Peng and Hou, 2009; Peng and Hou, 2010; Hou *et al.,* 2010). However, it is obvious that mere presence of different people close to each other hardly offers a sufficient condition for occurrence of quantum entanglement between any biological structures of their bodies. Also, synchronicity phenomena (correlation of mental processes in different subjects) may, generally speaking, be observed even if these people have never communicated with each other. Therefore, it seems prudent to put forth a hypothesis, whereby quantum entanglement occurs, and is subsequently maintained, at the level of genetic material.

In addition to other studies of quantum coherence and quantum entanglement in biological molecules, possibility of these phenomena existing in nucleic acids, particularly in DNA, was also intensively studied in recent years (Ogryzko 1997; McFaden and Al-Khalili, 1999; Bieberich 2000; Schemp, 2003; Sirakoulis *et al.,* 2004; Tulub and Stefanov, 2007; Ogryzko, 2008; Cooper, 2009a; b). Analysis of development trends in this area of study allows to assume that this direction is very promising (Curtus and Hurtak, 2004; Ananthaswamy, 2010). It has been, for example, suggested that quantum effects may be responsible for morphogenesis processes (Hyland, 2003b), and represent, in a way, a link between genotype and phenotype (Rosen, 1996). Therefore, it is possible that DNAs of different cells within the same organism may be connected by quantum entanglement as a result of division of cell during mitosis. On the other hand, it is also fair to assume that quantum entanglement between DNAs of different cells may occur during meiosis, when gametes are forming. This situation may take place, for example, during homologous genetic recombination – crossing-over. It means that quantum entanglement may exist between cell structures of different organisms as well. There is, however, one important circumstance worth noting: theoretically, quantum entanglement between DNAs of brain cells may occur exclusively during embryogenesis. The explanation is as follows: as we know, nerve cells experience mitotic division only during prenatal period. During postnatal period, neurons do not divide. Small percentage of neural stem cells may be disregarded. As of today, several papers have been already devoted to the matters concerning quantum entanglement at the level of central nervous system cells (Pereira, 2007; Pereira and Furlan, 2009; 2010). At the same time, it should be noted that quantum entanglement may exist not only between nuclear DNAs of different cells. Any cellular structures interacting both before and during mitosis and meiosis processes, and afterwards, after cells have divided, ending up in different cells, may potentially represent elements which cause existence of quantum entanglement between molecules of different cells (Hameroff, 2004; Tulub, 2004). It is hardly possible to describe existence of quantum entanglement between biological molecules of different organisms without taking into account mitosis and meiosis processes. It is so because in order that quantum entanglement does occur between the objects of the microworld, such objects should have interacted. Generally speaking,

in case no interaction took place, the objects of the microworld will not be related with quantum entanglement. Some particular cases of quantum entanglement among fermions make an exception to this rule (Zhou, 2000; Vedral, 2003; Oh and Kim, 2004; Clark *et al.,* 2005; Vertesi, 2007; Jie and Shi-Qun, 2008; Habibian *et al.,* 2010). However, for these rare instances it is characteristic to adhere to a series of specific conditions. At this stage of science development it is premature to suggest that such conditions exist as applied to neurones of several different people. Furthermore, another important question requires our attention. It concerns not the quantum entanglement occurrence mechanism, but the problem of its long-term preservation. We are talking about the so-called decoherence, a process which involves destruction of quantum coherence under impact of electromagnetic fields and other factors. Decoherence involves transformation of states characterized by quantum superposition (the so-called 'pure' states) into states where quantum phenomena cannot be observed ('mixed' states). Nevertheless, recently this problem has also been tackled at with increasing success (Shabani and Lidar, 2005; Manfredi and Hervieux, 2006; Grace *et al.,* 2007), particularly in terms of understanding the processes occurring in DNA (Ogryzko, 2008; Cooper, 2009a; 2009b). And finally, we still have to find out how quantum entanglement may occur between cellular structures of quite large number of subjects, because during meiosis, genetic materials may be transferred to descendants only. A hypothesis may come to rescue, whereby all humans originated from the same center in Africa approximately 80-200 thousand years ago – 'recent single-origin hypothesis' (Batzer *et al.,* 1994; Armour *et al.,* 1996; Liu *et al.,* 2006; Pritchard *et al.,* 1996). Not extending, surely, the assumption of existence of quantum entanglement onto the scale of genome of all people, one may, nevertheless, assume that certain population groups bear in their genetic material DNA parts inherited from prehistoric men, which are common to these groups (Goldstein *et al.,* 1995; Jorde *et al.,* 1995; Nei and Takezaki, 1996; Hey, 1997). Therefore, existence of quantum entanglement between DNA molecules of relatively large groups of people cannot be ruled out.

Considering the aforementioned hypothesis, we can assume that 'material carriers of consciousness' include, in particular, molecular orbitals (electron shells) of molecules, biologically active during meiosis and mitosis. This conclusion is helped by phenomenology of analytical psychology, namely the synchronicity phenomenon.

An assumption that the molecules participating in meiosis can play a role of tangible media of consciousness, apart of the other biological molecules, by no means contradicts our formed presentation that the human psyche is 'localized' in the brain. An absence of such contradiction is conditional on the circumstance that the molecules displaying biological activity during meiosis are viewed merely as an 'intermediate' link when quantum entanglement is formed between brain cell molecules of various people. The molecules participating in a cell division during meiosis may appear as 'intermediaries' while the quantum entanglement is formed between certain brain cell molecules of a person with the same molecules of the brain cells belonging to another person. In its turn, biological molecules used during mitosis can be similar 'intermediaries' in the course of quantum entanglement formation. However, the molecules used during mitosis can ensure a formation of quantum entanglement not between molecules of various people but between the cell molecules of one human organism. Specifically, it can occur between the brain cell molecules and the molecules which are active when forming gametes of one and the same person. As it has already been noted, quantum entanglement between the molecules of brain neurons of an organism may, theoretically, arise during embryogenesis exclusively. Quantum entanglement between the brain cell molecules and the molecules of other cells within one and the same organism may also arise exclusively in the process of prenatal development. Among other things, it also refers to quantum entanglement arising between the brain cell molecules and the cell molecules of other organs wherein meiosis takes place within the frame of one organism. Still, quantum entanglement

between the cell molecules of the organs wherein meiosis within the frame of one organism takes place may occur not only during embryogenesis but also in the postnatal period.

Again, an assumption that genetic material can be a tangible medium of consciousness has been contemplated so far by a number of researchers (Dennis 2010; Taric *et al.,* 2010) and is not viewed now as something remarkable. Recently there also appear papers (Vaas, 1999; Molyneux, 2010) which allow of a rather skeptical attitude to a stereotyped notion that the nature of a human psyche is conditioned by electric transfer of signal in the brain.

In this context it should be pointed out that orientation to quantum effects when trying to explain the nature of consciousness and, specifically, orientation to quantum entanglement phenomenon (including at the genetic material level) seems more than justified. To corroborate this thesis let us consider modern information technologies. Complexity of contemporary supercomputers and computer networks, a number of electronic links therein and the volume of transferred information may be currently comparable with certain similar indices applicable to describe human brain properties. However, as yet nobody saw (generally, it is hard to imagine that anybody could have observed such a thing) any technical device possessing consciousness which operating principle was based upon a transfer of electronic signals. It refers, inter alia, to technical devices developed within the framework of artificial intelligence studies. Therefore, it appears highly doubtful that the brain of a newborn, able to transfer electric pulses only, is an adequate medium of consciousness and can provide for a development of the personality possessing intelligence. It seems so that the brain molecules of an individual are to be linked, via a genetic material and by means of quantum entanglement, with genetic material (and molecules at the level of the central nervous system) of a great number of other people.

Characteristically enough, a famous British biologist Rupert Sheldrake has come up with a similar hypothesis at his time, assuming that correlation of mental processes in different people is caused by DNA. At the same time, Sheldrake did not specify what physical mechanism precisely may be responsible for this correlation. And only some other authors have reviewed the Sheldrake's theory in light of quantum non-locality (Keutzer, 1982; Resconi and Nikravesh, 2008). Also, key provisions of analytical psychology were viewed at in connection with David Bohm's theory of holomovement and Karl Pribram's holographic brain theory (Zinkin, 1987). Besides Jung, the assumption that mental processes somehow correlate with certain processes occurring beyond human brain was put forth at the time by John Eccles, laureate of the 1963 Nobel Prize in Physiology (Popper and Eccles, 1977) jointly with Wilder Penfield (Penfield, 1978).

The hypothesis outlined in this article may be viewed at a different angle. As we know, phenomena which quantum mechanics deals with in no way fit the perception of surrounding world which we carry in everyday life. This is also true about the principle of superposition in quantum theory, a phenomenon when, for example, an object of microworld may be 'located' in several points of Hilbert space 'simultaneously' (Garraway and Knight, 1994; Haroche *et al.,* 1997; Deléglise *et al.,* 2008). Back in his time, one of the founders of quantum theory Erwin Schrödinger showed that as a result of this principle, one can model a situation when a living creature, for example a cat, may be both 'alive' and 'dead' at the same time. However strange this thought experiment might seem to us, at this time practical experiments aimed at realization of quantum superposition at macroscopic level are already underway (Gevaux, 2010; O'Connell *et al.,* 2010). One of the consequences of existence of quantum entanglement between chromosomes of brain neurons in different people may be the fact that consciousness is not 'localized' in brain of an individual but, in the essence, 'simultaneously' 'belongs' to a group of people. This point of view is rather closer to Arnold Mindell's transpersonal interpretation (Mindell, 2000; 2004) than, in fact, to the theory of collective unconscious.

Conclusions and prospects of this study

Progress in various areas of modern natural science allows hoping that Carl Jung's concept of synchronicity will, after all, receive scientific explanation. Surely, one shouldn't get carried away on a tide of euphoria, ecstatically accepting 'trendy' applications of the quantum entanglement phenomenon. Scientific practice implies experimental confirmation of hypotheses, not ruling out their disproof as well. In author's opinion, the hypothesis outlined in this article implies verification of currently available data to explain the nature of synchronicity phenomenon.

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