Quantum, consciousness and panpsychism: a solution to the hard problem

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Abstract

We analyze the results and implications of the combination of quantum and consciousness in terms of the recent QSC analysis. The quantum effect of consciousness is first explored. We show that the consciousness of the observer can help to distinguish the nonorthogonal states under some condition, while the usual physical measuring device without consciousness can't. The result indicates that the causal efficacies of consciousness do exist when considering the basic quantum process. Based on this conclusion, we demonstrate that consciousness is not reducible or emergent, but a new fundamental property of matter. This provides a quantum basis for panpsychism. Furthermore, we argue that the conscious process is one kind of quantum computation process based on the analysis of consciousness time and combination problem. It is shown that a unified theory of matter and consciousness should include two parts: one is the complete quantum evolution of matter state, which includes the definite nonlinear evolution element introduced by consciousness, and the other is the psychophysical principle or corresponding principle between conscious content and matter state. Lastly, some experimental suggestions are presented to confirm the theoretical analysis of the paper.

Key words: quantum process, consciousness, distinguish the nonorthogonal states, causal efficacies of consciousness, fundamental property of matter, panpsychism, quantum computation, definite nonlinear evolution, psychophysical principle, a unified theory of matter and consciousness

Introduction

Consciousness is the most familiar phenomena. There are two distinct processes relating to the phenomena. One is the objective matter process such as the neural process in the brain, and the other is the concomitant subjective conscious experience. The relationship between matter process and conscious experience presents a well-known hard problem for science (Chalmers, 1996). It retriggers the debate about the long-standing dilemma of panpsychism versus emergentism recently (Seager, 1999; Seager, 2001). Panpsychism asserts that consciousness is a fundamental feature of the world which exists throughout the universe. Emergentism asserts that consciousness appears as an emerging result of the complex matter process. It is generally accepted that an essential separation of consciousness and matter will preclude any real integration of consciousness with the present scientific picture of the physical world, and panpsychism and emergentism are the only two main positions that can complete the integration. Then we must decide whether and how consciousness emerges from mere matter or whether consciousness is a fundamental property of matter.

Emergentism is the most popular solution to the hard problem of consciousness. But many doubt that it can bridge the explanation gap ultimately (Chalmers, 1996). On the other hand, although panpsychism may provide an attracting and promising way to solve the hard problem, it also encounters some serious problems. It is widely argued that the physical world is causally closed, and the consciousness property assigned by the panpsychism must lack all causal efficacies, i.e. there is a purely physical explanation for the occurrence of every physical event and these explanations don't refer to any consciousness property (McGinn, 1999). But if panpsychism is true, the fundamental consciousness property should take part in the causal chains of the physical world, and present itself in our investigation of the physical world. Then whether or not do the causal efficacies of consciousness exist? and where to find them if they do exist?

Recently a principle of QSC (Quantum Superluminal Communication) is presented based on the proper combination of quantum and consciousness (Gao, 2004). The new analysis may have some deep implications for the nature of consciousness, and may help to solve the above problems. As we know, quantum theory is the most basic physical theory in our times, and it provides us the deepest understanding about the physical world. Thus it is not irrational to consider the system with consciousness in quantum state, and study the possible connection between consciousness and

quantum process. In fact, Penrose and Hameroff had presented a concrete quantum theory of consciousness (Penrose, 1994; Hameroff et al, 1996; Hagan et al, 2002), and Albert had also analyzed the observer in quantum superposition in detail (Albert, 1992). In this paper, we will mainly study the results and implications of the combination of quantum and consciousness in terms of the new QSC analysis. In sections 2 and 3, the quantum effects of consciousness are first explored. It is shown that the consciousness of the observer can help to distinguish the nonorthogonal states under some condition, while the usual physical measuring device without consciousness can't. These results indicate that the causal efficacies of consciousness do exist when considering the basic quantum process. In section 4, we argue that consciousness is not reducible or emergent, but a new fundamental property of matter based on the analysis of the quantum effect of consciousness. This provides a quantum basis for panpsychism. In section 5, we further argue that conscious process is one kind of quantum computation process based on the analysis of consciousness time and combination problem. Section 6 shows that a unified theory of matter and consciousness should include two parts: one is the complete quantum evolution of matter state, which includes the definite nonlinear evolution element introduced by the consciousness property, the other is the psychophysical principle or corresponding principle between conscious content and matter state. In section 7, some experimental suggestions are presented to confirm the theoretical analysis of the paper. Conclusions are given in the last section.

Consciousness and physical measurement

We will first analyze the role of consciousness in the physical measurement process. As we know, physical measurement generally consists of two processes: (1). the physical interaction between the observed object and measuring device; (2). the psychophysical interaction between the measuring device and the observer. In some special situations, measurement may be the direct interaction between the observed object and the observer.

Even though what physics studies are the insensible objects or matter, the consciousness of the observer must take part in the last phase of measurement. The observer is introspectively aware of his perception of the measurement results. Here consciousness is used to end the infinite chains of measurement. This is one of the main differences between the functions of a physical measuring device and an observer in the measurement process. But unfortunately the difference seems to be not able to be identified using physical methods. Then whether or not the consciousness of the observer

possesses some physically-identified different functions from those of the physical measuring device? In the following, we will give a primary analysis.

In classical theory, the influence of the measuring device or the observer to the observed object can be omitted in principle during measurement process, and the psychophysical interaction between the observer and the measuring device does not influence the reading of the pointer of the measuring device either. Thus measurement is only a plain one-to-one mapping from the state of the observed object to the pointer state of the measuring device and further to the perception state of the observer, or a direct one-to-one mapping from the state of the observed object to the perception state of the observer. The consciousness of the observer possesses no physically-identified different functions from those of the physical measuring device in classical theory.

However, the measurement process is no longer plain in quantum theory. The influence of the measuring device to the observed object can't be omitted in principle during quantum measurement owing to the existence of quantum superposition. It is just this influence that generates the definite measurement result to some extent. Since the measuring device has generated one definite measurement result, the psychophysical interaction between the observer and the measuring device is still a plain one-to-one mapping, and the process is the same as that in classical situation. But when the observed object and the observer directly interact, the existence of quantum superposition will introduce a new element to the psychophysical interaction between the observer and the measured object. The interaction will result in the appearance of the conscious observer in quantum superposition. Presently, it is still unclear that what the conscious perception of the observer in the quantum superposition state or superposition state is. Albert had analyzed the similar quantum observer in detail (Albert, 1992). He denoted that the perception may be very strange. Then whether or not the consciousness of the observer in superposition state possesses some physically-identified different functions from those of the physical measuring device? We will try to give the answer in the following section.

A quantum effect of consciousness

Quantum theory is the most basic physical theory of nature. But as to the evolution of the wave function during measurement, present quantum theory provides by no means a complete description, and the projection postulate is just a makeshift (Bell, 1987). It is generally expected that a complete

quantum theory should describe the projection or collapse as a dynamical process of wave function, and provide a unified evolution law of the wave function. Revised quantum dynamics (Ghirardi et al, 1986; Pearle, 1989; Diosi, 1989; Ghirardi et al, 1990; Penrose, 1996; Gao, 1999a, Gao, 2000a; Gao, 2001a; Gao, 2003a) and many-worlds theory (Everett, 1957; Dewitt et al, 1973; Deutsch, 1985) are two main alternatives to a complete quantum theory. Here we mainly discuss the possible quantum effects of consciousness in the framework of revised quantum dynamics, and the conclusion will be also valid in the many-worlds theory. At the present time, even if the last complete theory has not been found, but one thing is certain, i.e. the collapse process of wave function is one kind of dynamical process, and it takes a finite time interval to finish. The following analysis will only rely on this common character of revised quantum dynamics.

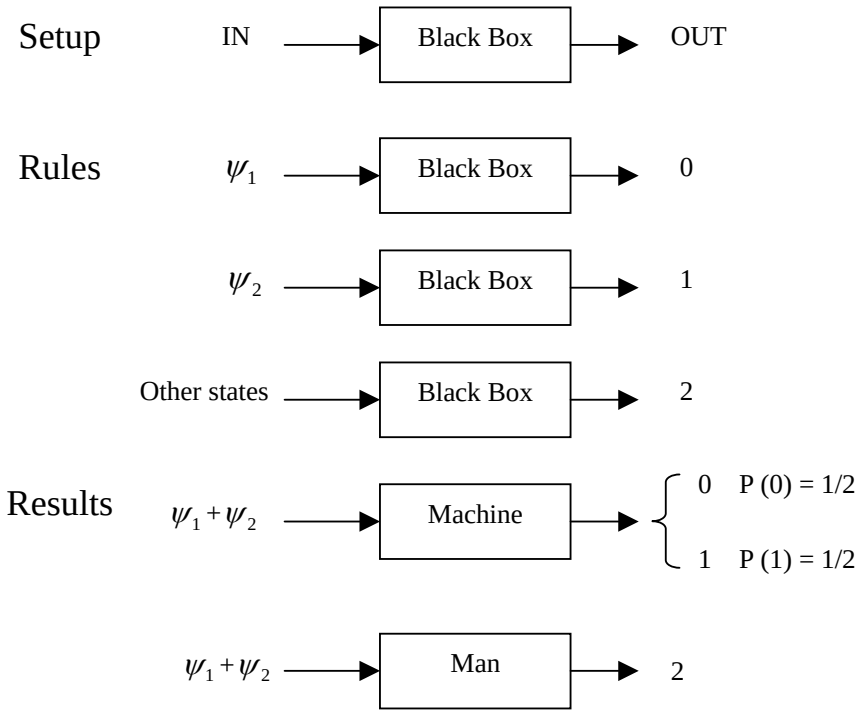
As we know, present quantum theory doesn't permit the nonorthogonal quantum states or nonorthogonal states be distinguished. What's more, in the framework of revised quantum dynamics, the usual measurement using the physical measuring device can't distinguish the nonorthogonal states either. But when the physical measuring device is replaced by a conscious being and considering the influence of consciousness, it can be shown that the nonorthogonal states can be distinguished in principle in the framework of revised quantum dynamics (Gao, 1999b; Gao, 2000a; Gao, 2003a; Gao, 2004). Thus the distinguishability of nonorthogonal states reveals a quantum effect of consciousness. Here we will reformulate the main demonstrations.

Let the measured state be $\psi_1 + \psi_2$, and the initial state of the physical measuring device be φ_0. After interaction the resulting entangled state of the whole system is $\psi_1\varphi_1 + \psi_2\varphi_2$, and the result state of the physical measuring device after collapse will assume φ_1 or φ_2 with the same probability 1/2 in a completely random way. We define a simple rule, i.e. let the output of the device be numbers 0 and 1 for the input states ψ_1 and ψ_2 respectively, and let the output of the device be numbers 2 for the other input states. Then the output of the device will be a random series of 0 and 1 with the same distribution probability 1/2 after measuring a large number of input states $\psi_1 + \psi_2$.

Now let the state $\psi_1 + \psi_2$ input to a conscious being. For example, ψ_1 and ψ_2 is respectively the states of a small number of photons with a certain frequency entering into the perception part of the conscious being from the directions 1 and 2, which can trigger different definite

perceptions of the conscious being, and the state $\psi_1+\psi_2$ is a direction superposition state of such photons. Let the initial perception state of the conscious being be χ_0, then after interaction the resulting entangled state of the whole system is $\psi_1\chi_1+\psi_2\chi_2$, where χ_1 and χ_2 is respectively the perception states of the conscious being for the states ψ_1 and ψ_2. We assume the conscious being satisfies the following QSC condition, i.e. the collapse time t_C of the entangled state is longer than the normal conscious time t_P of the conscious being for the definite state, and the time difference is long enough for him to identify. Then after the conscious time t_P, the state of the whole system turns to be $\psi_1\chi_{1,S}+\psi_2\chi_{2,S}$ owing to the consciousness ability of the conscious being, where the index s in $\chi_{1,S}$ and $\chi_{2,S}$ denotes that the conscious being is conscious that the input state is a superposition state, not a definite state. For an input definite state the conscious being forms a definite perception of the input state after the time interval t_P, whereas for the input superposition state $\psi_1+\psi_2$, the conscious being has not formed such a definite perception after the time interval t_P yet. The conscious being in a superposition state generally has no definite perception relating to the state. Finally, the state of the whole system $\psi_1\chi_{1,S}+\psi_2\chi_{2,S}$ collapses to the definite state $\psi_1\chi_{1,S}$ or $\psi_2\chi_{2,S}$ with the same probability 1/2 in a completely random way after the longer time interval t_C.

Since the collapse state $\chi_{1,S}$ or $\chi_{2,S}$ for the input superposition state $\psi_1+\psi_2$ is different from the normal perception state χ_1 or χ_2 for the input definite state ψ_1 or ψ_2, the conscious being can distinguish the nonorthogonal states $\psi_1+\psi_2$ and ψ_1 or ψ_2. This reveals a quantum effect of consciousness. The physical measuring device without consciousness can’t bring such quantum effect. It can’t distinguish the nonorthogonal states. The above analysis can be clearly depicted in the following black box system:



If a machine without consciousness is in the black box, the output will be a random series of 0 and 1 with the same distribution probability 1/2 after measuring a large number of input states $\psi_1+\psi_2$; If a conscious being is in the black box, the output will be 2 with certainty according to the rules, since the conscious being can distinguish the nonorthogonal states $\psi_1+\psi_2$ and ψ_1 or ψ_2, for the latter the rules restrict the output as the number 0 or 1, and for the former the rules restricts the output as the number 2. It is just the quantum effect of consciousness that results in the different outputs for man and machine. Certainly, the different outputs can be used to test the existence of consciousness, and further differentiate man and machine.

It should be denoted that the above quantum effect of consciousness relies on an apparently unusual condition, i.e. the conscious time of the conscious being for the definite state is shorter than his conscious time for the superposition state, and the time difference is long enough for him to identify. It is shown that the condition can be satisfied in principle (Gao, 2003a; Gao, 2004), and some evidences have indicated that our human being may satisfy the condition when in some special states (Duane et al, 1965; Targ et al, 1974; Puthoff et al, 1976; Radin et al, 1989; Grinberg-Zylberbaum et al, 1994; Gao, 2000a; Wackermann, 2003).

Consciousness is a fundamental property of matter

In this section, we will further demonstrate that consciousness is a fundamental property of matter, and is not reducible or emergent. This may provide a quantum basis for panpsychism.

As we have demonstrated, the conscious being or the matter with consciousness can distinguish the nonorthogonal states, while the usual physical measuring device or the matter without consciousness can't. This seems to be also possible if consciousness is reducible or emergent, but there exists an essential difference here. If consciousness is reducible or emergent, then the matter with consciousness should also follow the basic physical principles such as the principle of energy conservation etc. As we know, according to the basic quantum superposition principle in quantum theory, the nonorthogonal states can't be distinguished using the physical measuring device without consciousness. But the observer or the matter with consciousness can distinguish the nonorthogonal states in principle, and then consciousness evidently violates one of the basic physical principles---quantum superposition principle. Thus consciousness should be not reducible or emergent, but a new fundamental property of matter.

On the other hand, if consciousness is a new fundamental property of matter, then it is very natural that it violates the present basic physical principle, which doesn't include it as one fundamental property of matter. It is expected that a complete theory of matter must describe all properties of matter, thus consciousness, the new fundamental property of matter, must enter the theory from the start. Since the distinguishability of nonorthogonal states violates the basic linear superposition principle of wave function, the consciousness property of matter will introduce a new nonlinear evolution element to the complete equation of wave function. The non-linearity is definite, not stochastic. It is argued that the nonlinear quantum evolution introduced by consciousness is logically consistent and may exist (Czachor, 1995; Gao, 2004). Besides, we may use the definite non-linearity element in the complete evolution equation of matter to define the consciousness property of matter. Then just like the other properties of matter such as mass and charge etc, consciousness is also a fundamental property of matter which can be strictly described in mathematics to some extent.

As we know, the most severe problem of panpsychism is the apparent lack of evidence that the fundamental entities of the physical world such as electrons and protons possess any consciousness features. Certainly, such "no evidence" argument can be reasonably disputed by noting that there may

not exist any signs of complex consciousness at the simplest level, and it may be very difficult to see them even when they do exist there. The existence of gravitation is a good example. Its extreme weakness between the fundamental entities doesn't disconfirm that gravitation is not a fundamental feature of the physical world (Seager, 1999; Seager, 2001). Now the existence of the definite nonlinear evolution introduced by consciousness may further help to solve the problem. Since such definite nonlinearity can be experimentally tested even for the evolution of the fundamental entities such as electrons and protons, the above analysis may provide a well-grounded and promising way to confirm the panpsychism doctrine.

It should be denoted that the above demonstration about the quantum basis of panpsychism is independent of the origin of the collapse of wave function. If the collapse of wave function results from the consciousness of the observer, then consciousness can still bring the quantum effect of collapsing the wave function, and consciousness should be also a fundamental property of matter in terms of the similar demonstration as the above one. If the collapse of wave function is independent of the consciousness of the observer, then the above demonstration is valid. Besides, as we have denoted, the above demonstration is also valid for many-worlds theory, in which the collapse of wave function doesn’t exist, and is replaced by the objective environment-induced decoherence process (Gao, 2004). In fact, the demonstration about the quantum basis of panpsychism only depends on two confirmed facts: one is the existence of the indefinite quantum superposition of the microscopic objects, which is confirmed by the paradigmatic double-slit experiment, the other is the existence of the definite conscious perception of the macroscopic observers, which is confirmed by our introspection.

Conscious process as quantum computation

If consciousness is a fundamental property of matter, it may be expected that its evolution is essentially a quantum process. In this section, we will argue that the conscious process is one kind of quantum computation, and the definite conscious experience appears as the result of such quantum computation.

Everyday experience shows that a definite conscious experience can only be obtained through a process finished in finite time interval, whereas the process itself is unconscious. The existence of finite conscious time is also confirmed by strict experiments (Libet, 1993). Whereas consciousness is a fundamental property of matter, the existence of such transition process from pre-consciousness to

consciousness may imply that the conscious process is essentially one kind of quantum collapse process or quantum computation. If the conscious process is some kind of classical process or classical computation, then since consciousness is a fundamental property of matter, and is not generated by the matter process, the system with consciousness should be conscious of its state and process at all times. Thus the transition process from pre-consciousness to consciousness will not exist. On the other hand, if the conscious process is one kind of quantum collapse process or quantum computation, then the system with consciousness will generally be in a quantum entanglement state or superposition state. Since the system in a quantum superposition of definite conscious states doesn't possess a definite conscious experience, the collapse process of such a quantum superposition to a definite conscious state will naturally correspond to the transition process from pre-consciousness to consciousness. Thus we conclude that if consciousness is a fundamental property of matter, the conscious process is one kind of quantum collapse process or quantum computation.

Besides, some psi phenomena such as telepathy, if exist, may also imply that the conscious process involves quantum collapse process and quantum computation. Some experiments have primarily revealed that the information transfer between the human brains can be achieved in some kind of nonlocal way (Duane et al, 1965; Targ et al, 1974; Puthoff et al, 1976; Radin et al, 1989; Grinberg-Zylberbaum et al, 1994; Wackermann, 2003). When the classical communication tunnels between the human brains are shut down, the information can be also transferred between them. This kind of information transfer process, if exists, will strongly imply that such process is one kind of quantum nonlocal process between two entangled brain systems, and the involved brain process or conscious process involves some kind of quantum processes. On the other hand, it is recently shown that the combination of quantum and consciousness can indeed result in the availability of nonlocal information transfer or superluminal communication between the conscious systems (Gao, 2004). This further supports the conclusion that the conscious process is one kind of quantum computation, and the definite conscious experience appears as the result of such quantum computation.

Quantum computation is one kind of parallel computation process (Nielsen et al, 2000). Owing to the existence of quantum entangled state, the information is processed simultaneously in the different branches of the state, especially in the different separated space regions spread by the state. Thus all kinds of information distributing in different space regions not only combine into a unified whole of conscious content, but also is processed in an accurately simultaneous way. The final result of such

quantum computation is the processing result about all the distributed information, which appears as a whole conscious experience with abundant binding content. Thus if consciousness process involves quantum computation, then the combination problem and the binding problem may be more properly solved in the quantum framework (Seager, 1999). The wholeness formed by the quantum entanglement is one kind of essentially inseparable quantum wholeness, in which the parts of the whole system possess no independent conscious states as well as matter states. Only the whole system in the quantum entangled state can possess an inseparable conscious state. In comparison, the classical wholeness is one kind of essentially separable wholeness, in which the parts of the whole system possess independent conscious states as well as matter states when in space-like separation. Thus the combination of classical parts can't form a new inseparable wholeness, whereas the combination of quantum parts can form a new inseparable wholeness through quantum entanglement. This indicates that the combination problem can be more properly solved in the quantum framework. Besides, the quantum entanglement and quantum computation can also provide a proper way to binding the conscious content distributed in different space regions, and help to solve the binding problem.

As a typical example, the conscious state of our brain is an inseparable wholeness, and its parts such as the neurons don't possess their independent conscious states. This character essentially coincides with that of quantum entangled state, but only approximately coincides with that of classical combination state. Furthermore, we can primarily work out the conscious time or the collapse time of the superposition state of conscious perceptions in terms of revised quantum dynamics. It will be shown that the theoretical value is quantitatively consistent with the measured value. This also supports the conclusion that the conscious process is one kind of quantum computation. As we know, the number of neurons which can form a definite conscious perception is in the levels of 10^4. In each neuron, the main difference of activation state and resting state lies in the motion of 10^6 Na^+s passing through the membrane. Since the membrane potential is in the levels of 10^{-2} V, the energy difference between activation state and resting state is approximately 10^4 eV. According to one kind of revised quantum dynamical theory (Percival, 1994; Hughston, 1996; Fivel, 1997; Gao, 2000a; Gao, 2001a; Adler et al, 2001), the collapse time of the superposition of the activation state and resting state

of one neuron is $\tau_c \approx \frac{\hbar E_p}{(\Delta E)^2} \approx (\frac{2.8Mev}{0.01MeV})^2 \approx 10^5 s$. Thus the collapse time of the superposition of two different conscious perceptions is $\tau_c \approx (\frac{2.8Mev}{100MeV})^2 \approx 1ms$, in which one conscious perception state contains 10^4 neurons in the activation state, and the other conscious perception state contains 10^4 neurons in the resting state. Thus the theoretical value of the collapse time of the superposition state of conscious perceptions or the conscious time is in the levels of several ten milliseconds. On the other hand, the measured value of the conscious time of our brain is in the levels of several hundred milliseconds (Libet, 1993). They are quantitatively consistent. It also indicates that a complex conscious process will generally contain many collapse processes. Besides, the theoretical value of the conscious time also coincides with the coherent 40Hz oscillation of neurons accompanying the appearance of conscious experience (Crick, 1994).

It should be denoted that the above conclusion is also supported by some concrete models of consciousness such as the Orch OR model. In the Orch OR model, protein assemblies called microtubules within the brain's neurons are viewed as self-organizing quantum computers (Penrose, 1994; Hameroff et al, 1996; Hagan et al, 2002). It is generally argued that the brain's neurons seem unsuitably warm and wet for delicate quantum computation which would be susceptible to thermal noise and environmental decoherence (Tegmark, 2000). However some recent calculations suggest that microtubules can avoid environmental decoherence long enough to achieve quantum computation (Hagan et al, 2002).

A unified theory of matter and consciousness

Since consciousness is a fundamental property of matter, the complete matter state should include the conscious content. Accordingly, a unified theory of matter and consciousness should include two parts: one is the psychophysical principle or corresponding principle between conscious content and matter state, and the other is the complete quantum evolution of matter state including the conscious content. Such complete evolution includes three evolution elements: the first is the linear Schrödinger element, the second is the stochastic nonlinear element resulting in the dynamical collapse of wave function, and the last is the definite nonlinear element introduced by the consciousness property.

Undoubtedly it is very difficult to find the corresponding principle between conscious content

and matter state. Some important analysis has been presented (Chalmers, 1996). Here we mainly discuss the definite nonlinear element introduced by the consciousness property. Although the final form of the definite nonlinear evolution element hasn't been found, we may give a primary analysis about its characters. As we have seen in the above discussions, the definite nonlinear evolution is displayed in the following quantum process:

$$(\psi_1+\psi_2)\chi_0 \rightarrow \psi_1\chi_{1,S}+\psi_2\chi_{2,S} = (\psi_1\chi_1+\psi_2\chi_2)\chi_{12}$$

where the state χ_{12} denotes that the conscious being is conscious that the input state is a superposition state, not a definite state. The appearance of the state χ_{12} indicates that the evolution is definite nonlinear. It may further imply that the definite nonlinear element introduced by consciousness may possess some kind of fundamental form, and the corresponding evolution may also bring some more basic effects. It can be seen that the existence of χ_{12} indicates that consciousness results in some special change of matter state during the collapse of wave function, which can't brought by the usual properties of matter. Since the change of matter state generally corresponds to the change of energy distribution among the parts of the system, the definite nonlinear evolution introduced by consciousness will change the energy distribution among the parts of the system. As we have argued, the conscious process essentially involves quantum computation, and the conscious system is generally in a quantum entangled state. Thus the definite nonlinear evolution introduced by consciousness can change the energy distribution among the parts of the entangled system. Owing to the nonlocal property of quantum entanglement, the evolution may also change the energy distribution among the parts of the bigger entangled system including the conscious system and the other outer systems.

The above conclusion can be further argued from the other points of view. By analogy, the fundamental properties of matter such as mass and charge can all result in the change of matter state and change the energy of matter. As a new fundamental property of matter, consciousness should also be able to change the matter state, especially change the energy of matter. Besides, the process producing the causal efficacy is generally companied by the transfer or change of energy. Since consciousness possesses the basic causal efficacy, it is reasonable that it can also result in the change of energy. Considering the limitation of energy conservation principle, what consciousness can change

should be the energy distribution among the parts of the system, not the whole energy of the system. Thus we find that the definite nonlinear evolution introduced by the consciousness property indeed possesses some kind of fundamental form, which closely relates to the energy distribution among the entangled parts of the conscious system. During the evolution, the entangled state of the system evolves in a definite nonlinear way according to the conscious content, which is determined by the specific structure of the state.

As an example, we give another quantum effect of consciousness resulted from the definite nonlinear evolution introduced by consciousness. Since the definite nonlinear evolution doesn't preserve the orthogonality of the states, such evolution can change the coherence of the branches of the states of the outer system entangled with the conscious system, and further change the statistic behavior of the outer system. As a typical result, the definite nonlinear evolution introduced by consciousness may in principle influence the statistic distribution of the measurement results of the outer random process, and there may also exist a correlation between the influenced results and the conscious content. It should be denoted that some experiments may have primarily revealed such kind of quantum effect of consciousness (Radin et al, 1989; Jahn et al, 1997; Ibison et al, 1998; Jeffers, 2003).

The above analysis presents a primary framework of a unified theory of matter and consciousness. It essentially includes two parts: the corresponding principle between conscious content and matter state and the complete quantum evolution of matter state including the conscious content. This unified theory may deserve to be called the true theory of everything. It will not only tell us how the matter with consciousness evolves, but also tell us how the conscious content relates to the matter state, and what conscious experience a given system possesses. As a prediction of the theory, since consciousness is a fundamental property of matter, and there exists a corresponding relation between the conscious content and matter state, a conscious machine can be in principle constructed. It can be reasonably guessed that the simplest conscious machine which can distinguish two given nonorthogonal states may be only composed of several qubits. Certainly, in order to build up a more complete unified theory of matter and consciousness, we need the organic combination of quantum theory, information science, neuroscience, cognitive science and psychology etc. This may be the biggest challenge to science in the 21st century.

Some suggested experiments

In order to confirm the existence of the new quantum effects of consciousness, which is the core of the demonstrations in this paper, we propose the following experimental schemes. The experiments can be conducted using human beings or animals.

1. Control experiment

Produce some photons with a certain frequency. Input them to the eyes of the subject. Test and record the conscious time of the subject through EEG (electroencephalograph) or his oral description.

2. Quantum perception experiment I

Produce the direction superposition state of the photons with the same frequency as stated in section 3. Input one branch of the superposition state to the eyes of the subject, and let the other branch freely spread (not input to a measuring device). Test whether the subject perceives the photons during the normal conscious time.

3. Quantum perception experiment II

Produce the direction superposition state of the photons with the same frequency. Input both branches of the superposition state to the eyes of the subject. Test whether the subject perceives the photons during the normal conscious time.

4. Perceptions entanglement experiment I

Produce the direction superposition state of the photons with the same frequency. Input the branches of the superposition state to the eyes of two independent subjects respectively. Test whether the subjects perceive the photons during the normal conscious time. It is suggested that the subjects are unfamiliar with each other before the experiment, which can be further confirmed by the phase incoherence of their brain waves.

If the subjects can only perceive the photons after a time interval longer than their normal conscious time in any case of the above experiments, then we will have confirmed the existence of “QSC condition” in human brains, which is the precondition of the existence of quantum effects of consciousness. Besides, we suggest that the subjects in the above experiments should be composed of three independent groups at least. The subjects in the first group are in normal state, the subjects in the second group are in meditation state, and the subjects in the third group are in qigong state.

5. Perceptions entanglement experiment II

Produce the direction superposition state of the photons with the same frequency. Input the branches of the superposition state to the eyes of two independent and isolated subjects respectively. Then stimulate one of the subjects using flashes at random intervals. Record his evoked potentials and the corresponding transferred potentials of the other subject. Test whether there exists statistical relevance between these two potentials. At the same time, ask the subjects whether they have some kind of conscious perception relating to the stimulations. The appearance of this kind of conscious perception will have confirmed the existence of quantum effect of consciousness, which can be also used to realize controllable human brain communication.

This experiment can be taken as the quantum version of Grinberg-Zylberbaum's experiment (Grinberg-Zylberbaum et al, 1994). The further experimental suggestions are stated as follows:

(1). Complete the experiment at much longer distance, e.g. at a distance longer than the bound distance 40km[1]. Here the possible classical signals with light speed can't be used to explain the statistical relevance between the potentials of the subjects. Thus we can strictly confirm that the possible human brain communication is one kind of superluminal and non-electromagnetic phenomena, and further confirm the existence of "QSC condition" in human brains.

(2). Replace the flashes with flickering light. Here the evoked potentials of the stimulated subject will contain some measurable frequency information. It is expected that the corresponding transferred potentials of the other subject will contain the same measurable frequency information. Then we can use the transferred frequency information to realize non-electromagnetic and superluminal human brain communication more reliably. This will finally confirm the existence of quantum effect of consciousness.

Conclusions

In this paper, the results and implications of the combination of quantum and consciousness is deeply analyzed in terms of the new QSC analysis. The quantum effects of consciousness are first explored. It is shown that the consciousness of the observer can help to distinguish the nonorthogonal states under some condition, while the usual physical measuring device without consciousness can't.

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[1] Some experimental results have shown that the maximum time delay between the transferred potentials and the evoked potentials is approximately 130 μs . Considering the value of light speed, the bound distance excluding the influence of classical signals with light speed is approximately 40km.

The result indicates that the causal efficacies of consciousness do exist when considering the basic quantum process. Whereas consciousness possesses the basic quantum effect, we demonstrate that consciousness is not reducible or emergent, but a new fundamental property of matter. This provides a quantum basis for panpsychism. It is further argued that conscious process is one kind of quantum computation process based on the analysis of consciousness time and combination problem. We also present a primary framework of a unified theory of matter and consciousness. It includes two parts: one is the complete quantum evolution of matter state, which includes the definite nonlinear evolution element introduced by the consciousness property, and the other is the psychophysical principle or corresponding principle between conscious content and matter state. Lastly, some experimental suggestions are presented to confirm the theoretical analysis of the paper.

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