

# Biological Origin of Consciousness and a Physical Model of Human Brain

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## ABSTRACT

The biological origin of consciousness is discussed based on my previous theory of consciousness, which predicts that there will be trillions of small systems in our brain each of which is temporarily identical to the entity of the consciousness. Possible experiments are suggested to test this theoretical prediction.

**Key Words:** Dark Matter; Identical Particle; Hard Problem; Combination Problem

**DOI Number:** 10.14704/nq.2017.15.3.1102

**NeuroQuantology 2017; 15, 3: 89-93**

## Introduction

Many philosophers believe that even if all physical mechanisms behind the neural networks of our brain have been discovered and explained, one cannot still be able to find the biological origin of consciousness (Chalmers, 1995). It indicates that only experiments cannot help us find the consciousness.

Therefore, in order to find the biological origin of consciousness, it is important, first, to develop a general theory of consciousness that can provide a basic principle to determine what kind of system is conscious, and, second, to predict where one can find the biological origin of consciousness in our brain based on the theory. Then the neurologists can perform experiments to test whether the consciousness is really in the place as predicted by the theory.

In my previous works (Li, 2013; 2016), I proposed a fundamental theory of consciousness that can explain why some systems are conscious and others are not. In this paper, I will continue to suggest where should neuroscientists look into, in our brain, in order to find the consciousness.

## Origin of Conscious Experience

Now most philosophers agree that conscious experiences cannot be reduced to structures and are produced by the phenomenal properties of some matter or some system, which is normally defined as conscious subject.

On the other hand, more and more people tend to believe that all matters have phenomenal properties and have some kind of conscious experiences, just as advocated by the panpsychism (Chalmers, 2012). But the ordinary matter is too simple to form the complex experience as our brain does; for instance, my theory of consciousness suggest that the ordinary matters cannot form the conscious experience of the time flowing so they are effectively not conscious.

## Logic or Common Sense

So now the problem is what kind of system can have “meaningful” phenomenal properties or conscious experiences just like ours?

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**Received:** 16 July 2017; **Accepted:** 28 August 2017



Obviously, there are two ways to solve this problem.

- (i) Find some way to combine the micro-experiences produced by ordinary matters to form macro-experience like ours.
- (ii) Find some single inseparable matter or some elementary particle that itself already can have macro experience.

For the strategy (i), William James (1895) gave a very strong argument that phenomenal properties cannot combine, which later has been named as the “combination problem” (Chalmers, 2011). If James were right, then the consciousness must be inseparable and we are left with one choice of the strategy (ii).

But many people (Chalmers, 2011) will immediately dismiss the strategy (ii) at a first glance because of the following three reasons:

first, it is unimaginable that there is such inseparable entity or elementary particle with such complex experience because which might imply that it must also have huge inner freedom; second, it is highly unimaginable that Nature can lock and stabilize this particle in our brain; and, third, even if the above two problems can be solved, it is also very unlikely this inseparable particle can find some way to interact or to feel the external world. In a word, they think the strategy (ii) is totally against the common sense and they expect James was wrong and they can find a way to combine phenomenal properties. Nevertheless, no one has really rebutted James’ argument logically.

Therefore, to be logical or to be common sense, that is the question. Most people choose to be common sense and they develop theory of consciousness claiming that the subject of the consciousness is a bunch of particles and consciousness is an emergent phenomenon.

But for some researchers like me, logic is much more important because there are lots of examples in science that are against common sense but never really against logic unless there is loopholes in the logic that have been temporarily missed.

So I tend to believe that consciousness is inseparable and I propose that the consciousness is some kind of elementary particle and might be a dark-matter particle.

## Properties of Conscious Subject

If James (1895) were right and the consciousness is inseparable, then it can be several choices for the consciousness as suggested by Chalmers (2011). For me, I believe the consciousness is an elementary particle that has the following properties:

First, it must have complex physical properties or huge inner freedom. It is unimaginable the elementary particle with simple physics can have macro experience.

Second, the type of conscious particles of different people must be different from each other, otherwise they will be the same consciousness, which means a consciousness will experience more than one brain’s inputs. Also see the 5<sup>th</sup> law in the final section.

Third, according to the equivalence principle of consciousness (Li, 2013), the consciousness particle is its own antiparticle just like Majorana particles (Pribrag, 2017). Therefore, it is neutral and seldom interacts with ordinary particles, which implies it might be some kind of dark-matter particle.

It is worth to explain why the conscious particle is its own antiparticle here. First, if in the eyes of the consciousness M, the physics of the consciousness M’ can be described by the state function  $\psi$ , then it can be proved that in the eyes of M’, the physics of M can be roughly described by  $T\psi$ , where T is the time reversal operator. Detailed deduction can be seen in Figure 4 in my previous work (Li, 2013). Second, by the equivalence of consciousness, physics of M and M’ should be roughly the same which means  $\psi \sim T\psi$ , which further implies that M should be its own antiparticle.

## Interaction Between Consciousness and External World

Just as pointed out in section 3, if the consciousness is an elementary particle, then Nature must find some way to stabilize this particle and help it interact with the external world. It seems almost a mission impossible at a first glance. In my previous work (Li, 2016), it is suggested that Nature might employ powerful indistinguishable principle of temporarily identical particles (TIP) to solve these problems.

The TIP principle states that if exchange of two particles or two systems will not cause any observable physical consequence during a short time span then they are defined as temporarily identical. If they are temporarily identical then



they may really exchange with each other thereafter.

In my previously work, I show that an almost isolated composite-particle system can be possibly temporarily identical with a dark-matter particle if their inner freedoms are close to each other.

Therefore, Nature might employ trillions of such isolated composite-particle systems in our brain to stabilize some dark-matter particle and use its phenomenal properties to produce the conscious experiences. The dark-matter particle is stabilized through frequently exchanging with these small systems. Because there are about trillions of such systems and the dark-matter particle goes through these systems around 0.1 second, so each system needs to be isolated for only about  $10^{-13}$  second which can be possibly done in the warm wet brain. Maybe one can see these small systems as 'giant' Cooper pairs.

It should be noted that there might be  $N$  such potential systems in total, but during a very short time span, maybe only  $n$  'lighted' systems are filled with the right number of particles and temporarily identical to the dark-matter particle. Therefore,  $n$  out of  $N$  can be used to represent the information experienced by the dark-matter particle while the experience is actually the following quantum state itself

$$\underbrace{|M\rangle \left( \bigotimes_{i=1}^n |G_i\rangle \right)}_A + \sum_i |A(M \leftrightarrow G_i)\rangle \quad (1)$$

$$= \sum |M\rangle \sum |G_i\rangle$$

where  $M$  represents the consciousness,  $G_i$  represents  $n$  'lighted' systems. The above quantum state has overlapped all possible states where some  $G$  has been exchanged with  $M$ . Note that coefficients have been neglected and the structure or information of the conscious experience is stored in the density matrix of this quantum state.

Now, it is clear that the brain can input information to the consciousness  $M$  by 'activating' different combination of the small systems out of  $N$  such systems through the neural network.

Because during the time that the dark-matter particle occupies, say, A 'box' of some such small system, the dark-matter particle cannot be really confined by the A 'box', because the dark-matter almost cannot interact with any ordinary matter except through the TIP principle. Therefore, it may come out of the box a little bit. Then it will immediately be moved to another 'box' (B) and the particles in B 'box' will be also

moved to the A 'box' also due to TIP principle. Because 'some part' of dark-matter particle has already come out the A 'box' before it is moved to B box, so not all the particles of B 'box' will be exactly placed inside the A 'box'. Instead, some of them will leak out of the A 'box'. Note that this process can be seen as a measurement process in quantum mechanics. Before measurement, no one knows how many particles will leak out of the 'box'. After measurement, the superpositional state will collapse to a definite quantum state with the definite number of particles outside the 'box'. This process should be also seen as a basic quantum computational step in our brain. Those leaking particles will immediately affect the neural network thereafter.

By trillions of such collapsing processes and by controlling the number of the leaking particles, the consciousness can interact with the external world. If these collapsing processes are completely out of control of the consciousness, then we may say this consciousness has no freewill. Otherwise, this consciousness has a freewill.

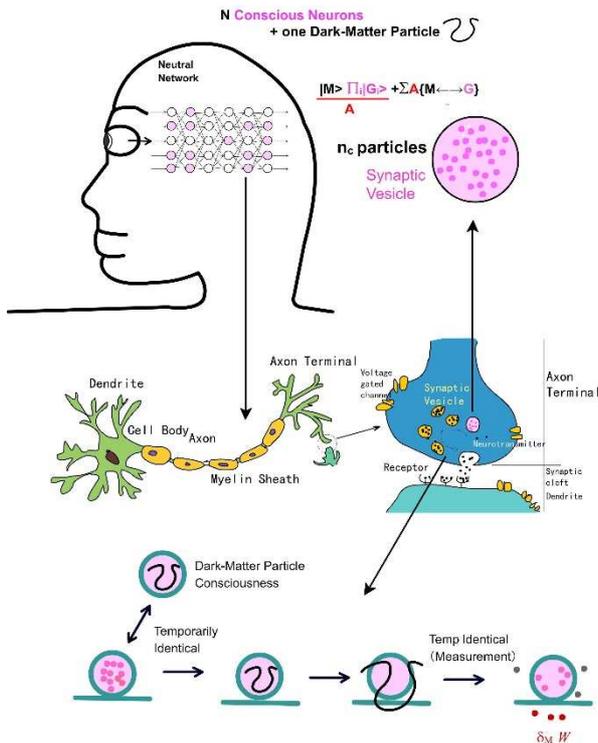
### Biological Origin of Consciousness

Specifically, I hypothesis that these  $N$  small systems, each of which can be potentially temporarily identical to the dark-matter particle, are actually those synaptic vesicles in the axon terminals. Note that only the synaptic vesicles with the right size that can host the right number of neurotransmitters that can be possibly temporarily identical to the dark-matter particle. We denote these vesicles as TI vesicles.

As can be seen in Figure 1, for an instant moment, only part of  $N$  conscious neurons (neurons that can possibly have TI vesicles) are lighted (pink nodes) or have TI vesicles at that moment. The pattern of the lighted neurons actually completely determines what we are experiencing at that moment.

Even though, the consciousness cannot precisely determine how many neurotransmitters should be leaked out of the vesicle for a single neuron ( $\delta_M w$ ), it can roughly determine the mode of  $\{\delta_M w\}$  of the neural network, which will affect the kinetics of the network thereafter. In this sense, the consciousness might have freewill. Note that in the above section, it has been pointed out in this process, there are actually trillions of collapsing events.





**Figure 1** Biological origin of consciousness. The pattern of 'lighted' conscious neurons (pink nodes), each of which is temporarily identical to the conscious particle, completely determines what we can experience; while the particles (neurotransmitters) that leaks into the synaptic cleft (red dots) or the variation of weights  $\delta_M W$  might indicate that we have freewill.

In the eyes of other consciousness, these events might be completely stochastic therefore there is still no freewill. But in the eyes of the consciousness M, these collapsing events might be totally determined by itself in theory. Nevertheless, M can be only 'aware' of some of these collapsing events or modes of the collapsing events, so M can only effectively control the mode of these collapsing events.

### Possible Experiments to Test the Theory

In this section three possible experiments are proposed to test the theory.

First, because the dark-matter particle will not interact with ordinary particles, so when the brain is dying the dark-matter particle will go away even if the brain is placed in a well-sealed container. Then the brain will lose some weight during the brain is dying. Nevertheless, this experiment might cost several billion dollars to build a scale that can detect whether a brain has lost some vesicle or not.

Second, because when our brain is functioning, the dark-matter particle will exchange with those synaptic vesicles, which will cause the neurotransmitters to disperse across the whole brain. For instance, the

neurotransmitters mainly responsible for vision will disperse from the vision region to other regions of the brain if there are too many experiencing events of vision during that time period. Therefore, one can do the following experiment. In the morning, measure the distribution of the neurotransmitters (V transmitter) that are responsible for vision across the brain for two persons. Then we cover A person's eyes with a black cloth, while expose B person in the sunshine for a whole day. In the evening, we measure the distribution again. If my theory is correct, then V transmitters will spread across B person's brain while V transmitters will basically remain in the vision region. But in the next morning, the V transmitters in A and B's brains will both mainly go back to the vision region. Certainly, in the real experiments, there might be some unexpected problems, but they can be overcome by nowadays techniques in principle.

Third, take a very small part of a rat's brain tissue (near vision region for example) that contains several thousand neurons out of its brain and keep it alive. Activate these neurons using electricity and study the correlation between this activation and the activity of the brain. If my theory were right, then there is manifested correlation because the dark-matter particle can freely move between these neurons and the rat's brain and acts as a messenger. This phenomenon cannot be explained by all other theories of consciousness or theories of brain, because there is no any physical connection between these two objects. I believe this experiment will shock the whole community in the future, so I encourage neuroscientists to do this experiment first.

### Six Laws of the Science of Consciousness

Finally, I summarize my theory of consciousness (Li, 2013; 2016) and this work in the following six laws.

**0th Law:** Conscious experiences are generated by the intrinsic attributes of the subject of consciousness, and physical complexity of the intrinsic properties of the conscious subject completely determines the potential complexity of the content of the conscious experiences. The intrinsic property is normally not structural. (see section 3.6 in Li, 2016)

**1st Law:** "I" is not in my world but in other's world. It is impossible to find the physical entity corresponding to the conscious subject M in its accompanied world W. But the physical entity



of the other consciousness M can be found in the world W' accompanied by M'. (see eq. (2) in Li, 2016, where M is obviously not in W.)

**2nd Law:** The intrinsic properties can not be combined. (see James, 1895)

**3rd Law:** Each flash of conscious experience always tries to include as much information as possible. If a conscious subject can only form a conscious experience flash, then it can not experience the time flowing and it will be equivalent to be unconscious. (see section 3.2 in Li, 2016)

**4th Law:** In the objective world W' accompanied by the consciousness M', the way in which the consciousness subject M interacts with the environment is the temporarily identical particle principle. The consciousness M constantly exchanges with some of the systems in the environment and will not cause any observable physical phenomena in a short period of time. (see section 5 in this work).

**5th Law:** Any two entities that are physically identical to each other are exactly the same consciousness. In the contrast, any two conscious entities that are not physically identical to each other are different consciousness's with different identities.

## Acknowledgement

I thank the financial supports from NSFC (No. 21534002, 21474021).

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