



# Consciousness is an Entity with Entangled States: Correlating the Measurement Problem with Non-Local Consciousness

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## ABSTRACT

The difficulty in solving the measurement problem may derive from a lack of thorough understanding of the nature of consciousness. Recent findings from parapsychological research and confirmed reports of veridical perceptions during near death experiences (NDEs) show that consciousness can acquire non-local information and may act as an independent entity outside of the body. But how apparent nonlocal properties of consciousness correlate with the measurement problem is unclear. Starting from the assumption that discrete states of consciousness are entangled with corresponding superposed eigenstates of an observed system, the findings of the double-slit experiment and delayed-choice quantum eraser experiment are reanalyzed and the non-locality of consciousness entity is derived from first principles. I propose experimental designs aimed at testing non-local entanglement between multiple consciousness entities that may help explain anomalous phenomena including telepathy, the role of “which-path information” in a measurement, and the nature of consciousness in non-human animals. Finally, I discuss the origin of the perception of time and the relationship between time and consciousness.

**Key Words:** Consciousness, Measurement Problem, Non-local, PSI, Near Death Experience, Entanglement

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## Introduction

The measurement problem in quantum mechanics can be expressed in the following way: Before being measured, the physical state of any system evolves continuously according to the Schrödinger equation as a linear superposition of eigenstates. After a measurement is taken, linear evolution is interrupted and the superposition of states is projected onto a single determinate eigenstate (Leggett, 2005; Genovese, 2010; Burgos, 2015). In this process, what a measurement is and how and when measurement takes place are remain unclear.

Some explanations of measurement problem avoid consciousness on the assumption

that consciousness cannot be reduced to (current) models of physics or represented using mathematic formalisms. However, it seems like eventual progress has not been made along this line (Galvan, 2010; Inamori, 2016). Others argue that consciousness should not be excluded from physical systems (Atmanspacher, 2003; Stapp, 2005; von Stillfried, 2011; Carter, 2014; Clarke, 2014; Hoffman and Prakash, 2014; Meijer, 2014; Baer, 2015; Goodman, 2017; Reddy, 2017), thus some models attempt to explain the role consciousness plays during the measurement process (Thaheld, 2005; Bitbol, 2008; Pilotti, 2011; Sanchez-Canizares, 2014; Baer, 2015; Pereira and Reddy, 2016; Okón and Sebastian, 2016).

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What is consciousness? Current psychology and neuroscience interpret consciousness as a “function” of the electrophysiological activity of the brain (Koch *et al.*, 2016). This description does not adequately explain the presumed role of consciousness in measurement. This viewpoint has been challenged by research findings on PSI (Achterberg *et al.*, 2005; Sidorov *et al.*, 2013; Scott *et al.*, 2015; Radin *et al.*, 2015; Radin *et al.*, 2016; Walach *et al.*, 2016; Jr. Daher *et al.*, 2017; Schwartz, 2017) and near death experiences (NDEs) (Fracasso and Friedman, 2011; van Lommel, 2011; Fracasso, 2012; Haesler and Beauregard, 2013; Parnia, 2014; Craffert, 2015; Lake, 2016; Gaiseanu, 2017; Lake, 2017), which suggest that consciousness may exist independently of one’s body and function in a non-local way.

The aim of this paper is to reconcile disparate understandings of consciousness with respect to its role in the quantum measurement process and transpersonal experiences by posing a simple assumption: consciousness is an independently existing entity that has different states entangled with corresponding eigenstates of an observed system.

In the first part of this paper, the double-slit experiment is reanalyzed to illustrate that the definite outcomes problem and the preferred basis problem stem from features of a consciousness entity. In the second part, the delayed-choice quantum eraser experiment is reviewed and the non-locality of a consciousness entity is derived. A model explaining the relationship between a consciousness entity, the body and the conscious states that we experience is proposed. In the third part, I propose experimental designs to empirically test the existence of non-local entanglement between multiple consciousness entities and an observed system. The role of “which-path information” in the context of the subconscious and the consciousness entity in non-human animals are discussed. In the fourth part, I explain how the sense of time is generated from a supposed static physical world.

### Double-Slit Experiment and Entangled Consciousness States

In the double-slit experiment, a photon simultaneously passes through both slits (S1 and S2) in a superposition state:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle + |S2\rangle ]$$

A detector (D1) is placed after the slit 1 at a position which only one eigenstate ( $|S1\rangle$ ) can register when the superposition collapses (Ellerman, 2011). Similarly, D2 is put after slit 2. Before the measurement is taken, the superposed eigenstates of the photon are entangled with the corresponding eigenstates of the detectors:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |D1 click\rangle + |S2\rangle |D2 click\rangle ]$$

After the measurement is taken, the superposition is presumed to project to one of the eigenstates, say,  $|S1\rangle |D1 click\rangle$ . In this process, the preferred basis problem (Galvan, 2010; Inamori, 2016) can be expressed as “why the superposition always collapses in a particular set of basis  $\{|D1 click\rangle, |D2 click\rangle\}$  rather than any other conjugate basis, such as  $\{\frac{1}{\sqrt{2}}(|D1 click\rangle + |D2 click\rangle), \frac{1}{\sqrt{2}}(|D1 click\rangle - |D2 click\rangle)\}$ ?”. The definite outcomes problem (Schlosshauer, 2005) can be expressed as “why only one eigenstate, either  $|D1 click\rangle$  or  $|D2 click\rangle$ , can actually appear after the measurement is taken.

Now, let us involve the states of consciousness in this superposition state, each of which entangles with a corresponding eigenstate of the system. (Let us just see the states of consciousness entity as the conscious states that we are able to experience in the normal waking condition. The differences between them will be discussed in the next section.)

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |D1 click\rangle |aware of D1 click\rangle + |S2\rangle |D2 click\rangle |aware of D2 click\rangle ]$$

Here, I postulate that 1) the number of states of a consciousness entity is limited, thus not every realizable state of a physical system has a corresponding entangled consciousness state, and 2) incompatible consciousness states cannot coexist simultaneously in a particular consciousness entity. Therefore, as soon as entanglement between the observed system and consciousness states has been established, the “self-collapse” of a consciousness entity will soon take place in order to make sure that only one state of a consciousness entity actually appears. It thus “drags” the superposition of the observed system and reduces it to a single determinate eigenstate. From this point of view, the preferred



basis problem and the definite outcomes problem respectively stem from the “limitedness” and “uniqueness” of the states of a consciousness entity.

### The Delayed-Choice Quantum Eraser Experiment and the Non-Locality of Consciousness Entity

Previous findings (Ellerman, 2011; Nagy, 2011; Zwirn, 2016; Fankhauser, 2017) support that, after passing through the double slit and the BBO, a single photon is converted into a pair of entangled photons (Figure 1). One photon (i.e., a signal photon) reaches a screen (D0) nearby while its twin photon (i.e., idler photon) travels through a pair of long pathways and is detected at one of four detectors (D1-D4) at the end of pathway. The consciousness-involved superposition can be written as below (Zwirn, 2016), where  $|O \rightarrow D1\rangle$  means a state of conscious awareness D1 click.

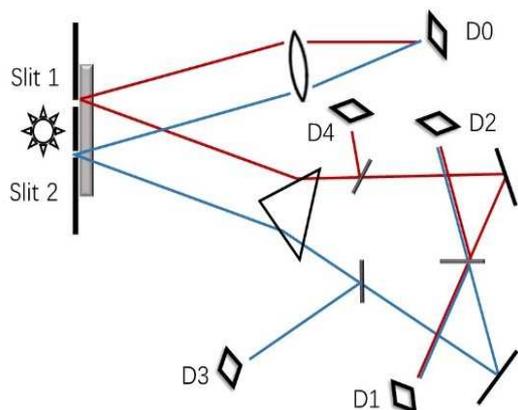


Figure 1. delayed choice quantum eraser experiment

$$\begin{aligned}
 |\psi\rangle = & \frac{1}{2\sqrt{2}} [ |S1\rangle + |S2\rangle ] |D0\rangle |O \rightarrow D0\rangle |D1\rangle |O \rightarrow D1\rangle \\
 & + \frac{1}{2\sqrt{2}} [ |S1\rangle + |S2\rangle ] |D0\rangle |O \rightarrow D0\rangle |D2\rangle |O \rightarrow D2\rangle \\
 & + \frac{1}{2} |S1\rangle |D0\rangle |O \rightarrow D0\rangle |D3\rangle |O \rightarrow D3\rangle \\
 & + \frac{1}{2} |S2\rangle |D0\rangle |O \rightarrow D0\rangle |D4\rangle |O \rightarrow D4\rangle
 \end{aligned}$$

When the observer confirms a photon impact at D0, this can be interpreted, as in the above case that the consciousness-involved superposition state has already collapsed. In other words, a particular state of a consciousness entity has already been generated (e.g.,  $|O \rightarrow D1\rangle$ ). However, the observer herself is not yet aware of the result of this collapse, as she needs to wait until the idler photon reaches D1.

Therefore, we may discover that a consciousness entity, which entangles with the observed system and triggers the collapse of the superposition, is not the same “thing” that we experience in the normal waking state. In other words, the generation of a particular state of a consciousness entity does not mean that we are able to be aware of that state or get any information about it. This experiment reveals the intrinsic non-locality of a consciousness entity, as entanglement and collapse can be established between a consciousness entity and events that happen in the future (e.g. the idler photon hits D1).

I am assuming that this non-local consciousness entity is (or at least *is related to*) events that takes place during a near-death experience (NDE) and contribute to verified reports of anomalous cognition involving apparent non-local information, such as precognition, clairvoyance and reincarnation (Tressoldi, 2011; Hitchman *et al.*, 2016). A consciousness entity probably exists in a higher dimension outside of the 4-dimensional space-time that biological organisms experience in ‘normal’ waking states (Sidorov *et al.*, 2013). The entanglement and collapse between a consciousness entity and the observed system may take place in a higher dimension space and thus is considered *non-local* from the viewpoint of ordinary perception.

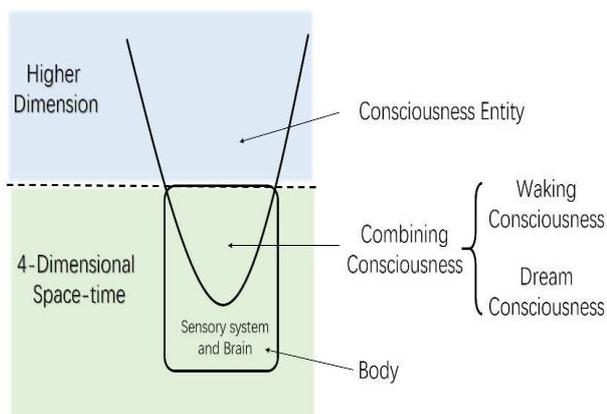


Figure 2. model of combining consciousness

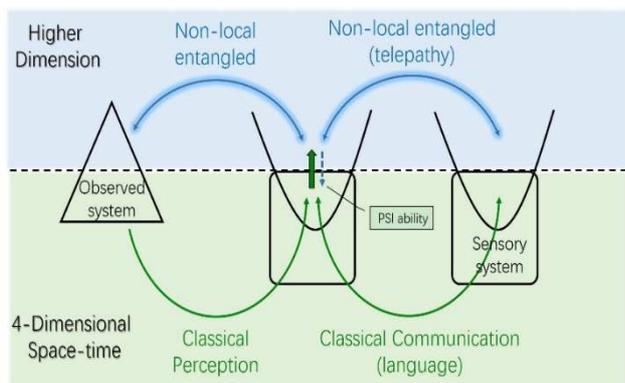
How humans (perhaps other species) could have a sense of both an outer world and inner mental activity has so far eluded scientific explanation. Specifically, what is the relationship between a consciousness entity and conscious states that everyone experiences on a day to day basis? I propose a model in which such ‘normal’



conscious states originate from a combination of a consciousness entity and a particular physical body, and refer to this process as “combining consciousness” (Figure 2). There are two forms of combining consciousness: waking consciousness and dream consciousness, which are probably different with respect to the patterns of combined consciousness entities and physical bodies.

According to the model, in a measurement waking consciousness does nothing but perceive the result of collapse through some classically established mechanisms that take place during ‘normal’ perception in the eye and brain mediated by light or sound waves. The whole measurement process is completely done by a consciousness entity itself and is unrelated to whether or not ‘normal’ waking consciousness will or be able to perceive the result (Figure 3, left part).

This model explains why perception of the physical world formed by a consciousness entity in the case of veridical NDEs and by ‘normal’ waking consciousness do not differ in significant ways (van Lommel, 2011; Fenwick, 2012; Haesler and Beauregard, 2013; van Lommel, 2013), even though disparate ways of obtaining information are involved. This is because waking consciousness does not generate new information, it only “reads” information that has been generated by a consciousness entity.



**Figure 3.** the entanglement between multiple consciousness entity and observed system in non-local way, and information acquired by combining consciousness in classical way

### Experimental Designs for Further Study on Features of a Consciousness Entity

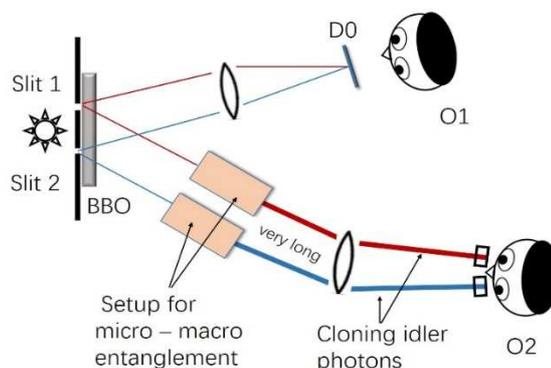
In this part, I put forward three experimental designs aimed at empirically testing the existence of entanglement between multiple consciousness entities, the issue of subconscious states and the consciousness entity in non-human animals. It should be noted that detectors cannot be used here and they must be replaced by naked human

eyes to receive photon signals. Because any use of a detector will open up the possibility of entanglement and collapse between the detectors and one consciousness entities, while the other consciousness entity will only read the results. Thus, we cannot know for sure whether two consciousness entities will entangle with each other directly.

In previous studies, detectors were indispensable because humans cannot be aware of a single photon no matter which eigenstate it is projected on. However, recent advances in photon cloning technology has permitted the construction of micro-macro entanglement between a photon and hundreds of clonings of its entangled twin (Sekatski *et al.*, 2009; Sekatski *et al.*, 2010; De Martini, 2011; Ghobadi *et al.*, 2013). This technology opens the possibility of cloning the idler photon into hundreds of photons that can be directly perceived by the naked eye while their superpositions of pathways are maintained.

### Experiment 1: non-local entanglement between multiple consciousness entities

Figure 4 illustrates the experimental setup. A human observer (O1) is instructed to observe D0 while another observer (O2) who is far away is using her naked left and right eye, respectively, to observe each pathway that cloning idler photons are traveling through.



**Figure 4.** Setup for experiment 1

If O1 finds the first hit at D0, this means a certain eigenstate has been projected from a consciousness-involved superposition, even though the waking consciousness of O1 cannot make sure which slit-eigenstate the observed system has been projected on. With the accumulation of photon impacts, if there is no interference pattern at D0 (which is the most likely result), the direct non-local entanglement



between two consciousness entities will be derived:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |O1 \rightarrow D0\rangle |O2 \rightarrow R_{eye}\rangle + |S2\rangle |O1 \rightarrow D0\rangle |O2 \rightarrow L_{eye}\rangle ]$$

It should be noted that similar with O1, (the waking consciousness of) O2 does *not know* the collapse result either, as the cloning idler photons have not reached either one of her eyes. Again, the establishment of entanglement between the observed system and the consciousness entities and the collapse of the superposition are unrelated to whether or not waking consciousness *can be aware of* the results.

The mutual entanglement and collapse of consciousness states provides a way of sharing non-local information between two consciousness entities. In most cases, such non-local information cannot be perceived by combining states of consciousness (both waking consciousness and dream consciousness), as information from a higher order space generally cannot flow to lower order space times (including, e.g., the physical world). However, in some life threatening situations such as severe trauma, the information may be “strong” enough to break through the barrier and be “felt” by combining consciousnesses. This leakage of non-local information thus contributes to the so-called anomalous phenomena such as telepathy (Figure 3, right part).

If the two pathways of cloning idler photons are respectively observed by two observers (O2 and O3), the whole process will remain the same, apart from the entanglement involving three consciousness entities and the observed system. In other words, multiple consciousness entities can be entangled with each other and the physical world at the same time. Thus, we could infer that the stable physical world that we (waking consciousness) perceive may be generated from the “collective collapse” triggered by multiple entangled consciousness entities.

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |O1 \rightarrow D0\rangle |O2 \rightarrow eye\rangle + |S2\rangle |O1 \rightarrow D0\rangle |O3 \rightarrow eye\rangle ]$$

### Experiment 2: which-path information in the subconsciousness level

As illustrated in Figure 5, two observers (O2 and O3) each use one eye to observe the signals of cloning idler photons and one eye to watch

rapidly flashing contour-rich patterns of high contrast light. This paradigm is called continuous flash suppression (CFS) (Kaunitz *et al.*, 2011; Yang *et al.*, 2014) and is commonly used in psychological studies on consciousness and perception. If two incompatible visual stimuli are simultaneously displayed to each eye of an observer, two resulting percepts will compete for conscious awareness of the observer. Normally, the perception of flashing patterns will result in long-term suppression of the perception of signals of cloning idler photons, with the result that O2 and O3 will be unaware of them, even though this visual information reaches their eyes and has been processed in their brains.

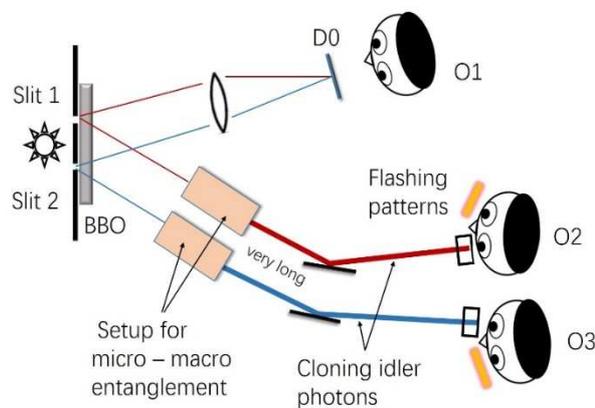


Figure 5. Setup for experiment 2

In this case, will there be an interference pattern at D0? According to the orthodox interpretation whether or not a superposition is projected on to a slit-eigenstate is determined by whether the “which-path information is available in principle”(Brukner, 2015). In this case, as this information is unavailable in principle to either O1, O2 and O3, there should be an interference pattern at D0. However, based on the model proposed in this paper, no interference pattern should be found, as the entanglement and collapse between the consciousness entities and the observed system is not affected by whether the “which-path information” is available to waking consciousness. Entanglement and collapse are determined by whether states of consciousness entities exist that can be potentially entangled with corresponding eigenstates of the observed system.

According to the current orthodoxy, the subconscious (i.e. so-called ‘subliminal perception’) entails information gathered by a sensory system that fails to emerge into waking



consciousness. However, the subconscious may play a more important role than conventionally believed. It is interesting to note that the subconscious is always emphasized in PSI abilities involving non-local information. This implies that the subconsciousness may act as the “pathway” for information leakage from a consciousness entity to combining consciousnesses.

### Experiment 3: animals' consciousness entity

This experiment is used to ascertain whether animals have consciousness entities that can be entangled with observed system and trigger a collapse. Before the test, two groups of animals (e.g. rats) are trained in two different ways below to report their perception of optical signals by pressing levels:

Group A: if finding a signal arrived at left eye, then press the left level; if finding a signal arrived at right eye, then press the right level.

Group B: no matter which eye detecting a signal, press the middle level.

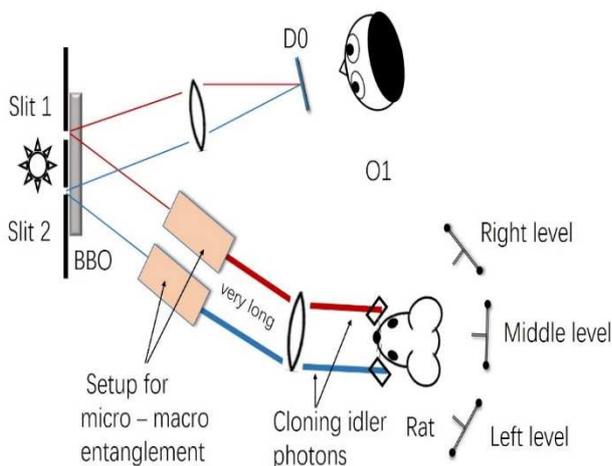


Figure 6. Setup for experiment 3

As illustrated in Figure 6, rats from these two groups are acted as observers. If rats do not have consciousness entity to entangle with and trigger a collapse of superposition state, then the observation of Group A will lead to no interference at D0 while the observation of Group B will cause inference pattern. In this case, the rats from two groups are theoretically equal to detectors which are placed at two different positions so that one group can only register one slit-eigenstate of the superposition (Group A) while the other can register a superposed state that can generate interference pattern (Group

B). In this case, the superposition can be written as:

Group A:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |press\ left\ level\rangle |O \rightarrow left\ level\rangle + |S2\rangle |press\ right\ level\rangle |O \rightarrow right\ level\rangle ]$$

Group B:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |press\ middle\ level\rangle |O \rightarrow middle\ level\rangle + |S2\rangle |press\ middle\ level\rangle |O \rightarrow middle\ level\rangle ] = \frac{1}{\sqrt{2}} [ |S1\rangle + |S2\rangle ] [ |press\ middle\ level\rangle |O \rightarrow middle\ level\rangle ]$$

On the contrary, if rats themselves are capable to trigger a collapse of superposition state, then observation by either Group A or Group B will lead to no interference pattern at D0. In this case, the consciousness entities of rats, O1 and the observed system are entangled and the superposition is collapsed regardless of whether waking consciousness of O1 is able to know the information.

Group B:

$$|\psi\rangle = \frac{1}{\sqrt{2}} [ |S1\rangle |O_{rat} \rightarrow R_{eye}\rangle |O_{human} \rightarrow middle\ level\rangle + |S2\rangle |O_{rat} \rightarrow L_{eye}\rangle |O_{human} \rightarrow middle\ level\rangle ]$$

If this experiment certifies that rats have consciousness entity that similar with human being, then it is possible that rats may also have some kinds of PSI ability. Thus, we could do some specifically-designed behavioral tests to pick out rats with stronger PSI ability and breed them for some generations to obtain a “high-PSI family”. Then we could explore whether or which psychological structures, such as which brain regions or gene are associated with PSI ability and further study the nature and characteristic of consciousness entity. Two experimental designs can be found in appendix.

### Consciousness Entity and the Sense of Time

Some theorists have argued that time may not really exist as an objective phenomenon in the physical world (Kiefer, 2017). However, if this were the case, there remains a question of how we can experience time in a postulated static universe. Here I would like to discuss this issue in the context of the model put forward in this paper.



As discussed above, the reality of the physical world has already been generated by the “collective collapse” triggered by multiple consciousness entities entangled with the superposed physical world. As this process is independent of the nature of time, it is conceivable that time does not really exist in the physical world.

As proposed in this paper, a combination of individual consciousness entities and the physical body in the physical world generates states of combining consciousness that we experience. This combination allows humans to perceive “time”. There are two forms of a *sense of time*, an objective sense of time and a subjective sense of time. The objective sense of time is the perception of so-called “physical time,” a physical quantity that can be measured by a clock that proceeds steadily and is not affected by subjective states of consciousness. In contrast, the subjective sense of time entails personal psychological feelings of *how fast* physical time *seems to* elapse, which is strongly associated with the unique mental state of each individual. In normal waking consciousness, both the objective sense of time and the subjective sense of time play roles, while in dreaming, only the subjective sense of time takes place.

I propose that objective time is generated from the combination of collective consciousness entities (i.e., the consciousness world) and the static 4-dimensional space-time physical world, while the subjective sense of time derives from the combination of individual consciousness entities and the individual body (Figure 7). Thus, individual waking consciousness can *perceive* but cannot *change* the objective sense of time, while the subjective sense of time is both perceivable and changeable.

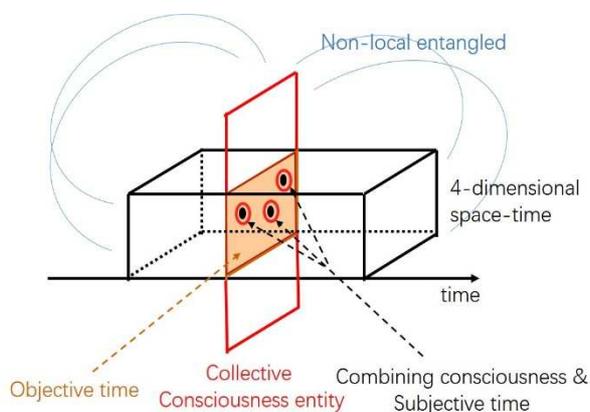


Figure 7. Objective and subjective of sense of time

Further, the subjective sense of time is correlated with both the pattern of combinations of conscious states (i.e., sleeping or waking) and physiological and energetic processes required to maintain those combinations of state. Changes in physiology and “energy consumption” contribute to the fluctuations in the subjective sense of time in different mental states (e.g. fear, happiness, excitement) and translate into differences in the subjective sense of time in children, adults and the elderly.

The “speed” of the subjective sense of time in normal waking consciousness is relatively more consistent than that in dreaming. This may be related to the fact that in waking consciousness, the objective sense of time can always influence the subjective sense of time by stabilizing a physical or physiological process (e.g. periodic motion or biological rhythms in the hypothalamus circuits that underlie ‘biological clocks’) that is necessary for maintaining a combination of consciousness states. In contrast, no such mechanism operates in dreaming.

It is interesting that the subjective sense of time experienced in lucid dreams is more similar to that reported in the waking condition than in non-lucid dreaming, suggesting that time sense in lucid dreaming is similar to objective time sense (Dresler *et al.*, 2012; Stumbrys *et al.*, 2012). This finding indicates that a process that does not exist in non-lucid dreaming is involved in lucid dreaming, and that this process is associated with differences in the “speed” of the subjective sense of time. It also suggests that the postulated periodic motion that play an important role in combinations of consciousness entities and the body.

## Conclusions

Until now, quantum mechanics and consciousness remain unexplained following decades of intensive research efforts. It appears that these two mysteries may be intrinsically linked so that the solution to one holds the key to the other (Carter, 2014). In this paper, I propose that consciousness is an independent entity characterized by discrete states entangled with superposed eigenstates of an observed system in a measurement process. I show that the non-locality of a consciousness entity in transpersonal and so-called anomalous experiences can be derived by reanalyzing the measurement process. Experimental designs are proposed to empirically test other features of a consciousness entity. I put

forward a model to illustrate that the conscious states we experience originate from a combination of consciousness entities and the body in higher-order space-times. Starting from this model, I propose a mechanism for anomalous perception involving non-local information and the generation of a capacity to sense time in a postulated static physical world. The hypothesis posed in this paper correlates the measurement problem with non-local consciousness and suggests ideas that may help solve both of problems.

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