

Mind and Tachyons: Six-dimensional Special Relativity - Tachyons May Inform Us about Our Future

Syamala D. Hari

ABSTRACT

This is another article in a series proposing that memory and thought in our brains consist of tachyons. During the 1970's and later, tachyon physicists found six-dimensional special relativity with three space and three time dimensions, more suitable for the description of tachyons than the conventional four-dimensional special relativity. In six-dimensional relativity, events observable by a subluminal observer and those by a superluminal observer are located on two different four-dimensional Minkowski subspaces in the higher dimensional space-time. If one assumes that information in the mind of a sentient observer consists of tachyons then the observer's brain and mind play the roles respectively of a subluminal and a superluminal agent, whenever he/she observes an external material object or an internal thought, emotion, etc. Six-dimensional special relativity then implies that the space-time of the physical world and the space-time of phenomenal information of the individual are different four-dimensional Minkowski sheets embedded in the six-dimensional space-time. Interestingly, this conclusion is compatible with the Material Dualism or Extended Materialism proposed by modern scientists, John Smythies, Bernard Carr, and others who think that physical world and phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time that includes at least one more dimension of time than the conventional four-dimensional special relativity. In six-dimensional special relativity, it is possible for tachyons to pass information about likely future states of a subluminal observer to the observer without violating causality. This feature of tachyons together with our hypothesis that intention, will, or volition all consist of tachyons, would explain why the unconscious neural activity called readiness potential precedes awareness of will/intention in the context of volitional or goal-oriented actions.

Key Words: six-dimensional special relativity, quantum brain, tachyons, conscious and unconscious thought, material dualism, extended materialism

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Introduction

In earlier papers, we proposed that memory and thought in human brains (possibly in other living beings) consist of tachyons. We consider the mind as accumulation of 'phenomenal information' (PI) that includes subjective experiences of sensory inputs and psychological contents such as desires,

emotions, feelings, volition, and sense of self. We propose that the PI which is not accessible to external observers by any physical means consists of tachyons defined and discussed by Bilaniuk et al. (1962), Feinberg (1967), and Recami (1986). Earlier, we showed that a brain consisting of neural matter and its mind consisting of tachyons can produce subjective experience in the form of

Corresponding author: S. D. Hari

Address: 309 Melvin Jackson Drive, Cary, NC 27519, USA

e-mail ✉ murty_hari@yahoo.com

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tachyons by interacting with each other (Hari, 2011; 2014). During the 1970's and later, tachyon physicists discussed six-dimensional special relativity (6D-SR) with equal number of space and time dimensions, as they found it more suitable for the description of tachyons than the conventional four-dimensional special relativity (4D-SR). In 6D-SR, events observable by a subluminal observer and those by a superluminal observer (if such an observer exists) are located on two different 4D-Minkowski subspaces in the 6D-space-time. If one assumes that information in the mind of a sentient observer O consists of tachyons, then the observer's brain and mind play the roles respectively of a subluminal and a superluminal agent, whenever O observes an external material object or an internal thought, emotion, etc. The 6D-SR then implies that the space-time of the physical world and the space-time of phenomenal information are located in different subspaces of the 6D-space-time.

We point out in Part I of this article, that the above conclusion is compatible with the Extended Materialism proposed by John R Smythies, a neuroscientist of today, who thinks that physical world and phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time that includes at least one more dimension of time than the conventional 4D-SR. Smythies explains that his theory of mind (TOM) is Substance Dualism but not Cartesian Dualism. Because the tachyon TOM is Extended Materialism also, it is also different from Cartesian dualism; there is no soul or homunculus in our theory.

In Part II of this article, we describe how it is possible in 6D-SR, for tachyons to pass information about likely future states of a subluminal observer to the observer without violating causality. We will see that this feature of tachyons together with our hypothesis that intention, will, or volition all consist of tachyons, allows us to explain why the unconscious neural activity called readiness potential precedes awareness of will/intention in the context of volitional or goal-oriented actions. We suggest that unconscious will initiates the neural activity.

PART I

Interactive dualism and extended SR with three space and three time dimensions

Besides information about matter, which physics has dealt with so far, minds contain other information such as thoughts, desires, feelings, and sense of self. Physicist Bernard Carr (2010) puts information in our minds into the following categories:

1. Information generated by perception of physical space through physical sensors and stored for use in replay of images and events experienced in the past.
2. Information generated and controlled by imagination, related to creativity.
3. Information in dreams possibly generated by the interplay of memory and imagination.

So far, all laws of physics are concerned only with information of the first kind above. Since the mind contains other information such as mentioned in the second and third categories above, Carr suggests that more than the usual four dimensions are needed to describe life consisting of both body and mind. The notion of extra dimensions beyond the three revealed by our physical senses has already been proposed by other physicists such as Kaluza and Klein to explain certain aspects of the material world. In all such theories, effects of the extra dimensions become important on certain scales. These theories therefore imply that our ordinary senses reveal only a limited aspect of physical reality. Carr (2010) proposed a "Universal Structure" in a higher-dimensional matter and information space to incorporate physical space as well as non-physical parts accessed only by the mind. Pursuing Carr's ideas, Smythies (2009) rejects Psycho-neural Identity Theory and proposes a theory of substance dualism, which he calls Material Dualism or Extended Materialism, according to which the brain and its phenomenal consciousness module are two ontologically independent parts of a human organism located in different but related subspaces of a higher dimensional space-time. This dualism differs from Cartesian dualism because in the latter, physical matter is extended but mind is not whereas both realms contain material, and both are spatial in the new dualism. Smythies (2003) observes that the 4D-SR as currently understood does not distinguish PI from the brain's matter and cannot recognize a 'now' of time. He thinks that in addition to the time t_1 of 4D-SR, a second time t_2 in which the 'observer's field of observation' moves through space-time is required in SR to

describe consciousness phenomena. Smythies (2014) therefore proposes a 5D space-time where a second time dimension is added to the space-time of 4D relativity, and where the physical world (containing ordinary matter such as atoms, fields, brains and planets) and the phenomenal world (containing phenomenal matter such as sensations, images and thoughts) are in relative motion and located in two different cross-sections of the 5D space-time. The relative movement, he says, generates the 'now' and the passage of the time that we experience. The contents of phenomenal space are all related to (but not identical with) particular brain events. In this article we are not working with Carr's Universal Structure or with Smythies' 5D space-time. We merely point out that our approach linking brain's neural matter with mind's tachyonic matter in 6D-SR not only satisfies Smythies requirements for an extended SR but also provides a clear mathematical formulation of a theory of Extended Materialism.

1. Some definitions

We will define some words/phrases which will be used frequently in the following sections.

Material events: We say that material events in space and time are events whose space and time coordinates can be found by a sentient observer by receiving energy, momentum, etc. via senses directly from them, or indirectly by means of physical instruments. Some information including the 'where and when' of an event is created in the mind of the observer upon receiving such signals. We will call creation of information as an observation of the material event.

Events in imagination (EI): Events such as dreams occur apparently without requiring receipt of signals via senses and physical instruments. We call such events as events in imagination (EI). It is not possible to associate space and time with EI-type events. For example, our dreams some of which we may be able to report to others are of this kind because an event in a dream for example, may not have happened and may never happen in the physical world.

Subluminal agent: *New information is acquired in an observation.*² An observer is a sentient being O

and acquires information via senses (by looking, hearing, etc.), about the space and time coordinates or a property of a material object either directly from the object or from a device used to measure the property. In the latter case, the measuring device records a change in its state by exchanging matter, energy, momentum, etc. with the material target of observation. When its response is received by O via senses, new information is created in O's mind; and O 'observes' the new state. We will say that *any object, which is subluminal relative to the body of a sentient observer, is a subluminal agent. It undergoes a change of state by exchanging energy, momentum, matter, etc. with other objects which may be bradyons or tachyons in its rest frame; it is said to 'access' the event at the other end of the exchange if the exchange is subluminal in its rest frame. Its own state is said to be accessible to it if a sentient observer can report the state using senses (speech, writing, etc.).*

Thus the brain of O is a subluminal agent when it creates neural maps of sensory signals, which it receives from a material event P_M in the outside world; the brain 'accesses' P_M ; the brain 'accesses' its new state BP_M because BP_M can be reported by a neuroscientist, who monitors the brain. In the case of EI-type events Q also, the brain undergoes a corresponding event BQ, by receiving endogenous inputs (like in the case of intentional actions) or even unknown inputs (like in some dreams), which we assume contain tachyonic signals of energy and momentum. According to our definitions, the brain 'accesses' BQ (because the neuroscientist can report it). We may say that the brain accesses Q by a superluminal exchange.

Superluminal agent: In tachyon physics, the word "superluminal observer" appears quite often but what does it mean? Although existence of tachyons is not ruled out by relativity theory, all sentient beings we know, and their rulers and clocks are all made out of ordinary matter and cannot move faster than the speed of light; we have not even observed any tachyons yet. So, in a way similar to how we defined a subluminal agent, we will say that *any object, which is superluminal relative to the body of a sentient observer, is a superluminal agent. It undergoes a change of state by exchanging energy, momentum, etc. with other objects which may be bradyons or tachyons in its*

² Remembering happens 'now' like every other experience. In a remembering experience one observes the content of the original experience and something more; it is the recognition of a past or the notion of 'again'.



rest frame; it is said to 'access' the event at the other end of the exchange if the exchange is subluminal in its rest frame. We say a superluminal agent 'accesses' its new state if a sentient observer can report the new state using senses (speech, writing, etc.).

If we hypothesize that PI consists of matter tachyonic relative to the external world perceived via senses, then according to our definitions of 'access', any content of the mind of a sentient being is a superluminal agent.

Observer and awareness: Note that in our definitions, subluminal and superluminal agents do not 'observe' anything. We define an observer as follows so that only a sentient observer with both a brain and a mind 'observes' or is 'aware' of the observed object: *A sentient being 'observes' or is aware of an object (which may be a physical object, or a past event, or a sensory experience in the present, or a future goal) when a physical representation (neural correlate) of that object and the 'meaning'³ of the neural correlate reportable to the outside world, both exist in the being's memory.*

Thus, a sentient observer 'observes' or is 'aware' of an event P (whether P is a material event P_M or EI-type event Q) if and only if there is a required corresponding brain event BP and he/she is also able to report/communicate the 'meaning' of BP using the senses. The observer sees the event P as happening 'now'. If one assumes that the brain is a quantum system, then its wave function collapses whenever it creates a neural record observable by a monitoring scientist. Hence this definition of awareness implies that the wavefunction collapses whenever the observer is 'aware' of something, or 'observes' something.

It is to be noted that the event of the brain's quantum collapse coincides with the occurrence of awareness of the new input but does not necessarily coincide with completion of building the neural correlate (sometimes called neuronal adequacy) of the input. This feature of quantum collapse is

believed to be the basis for Libet's Delay and Antedating Paradox (Wolf, 1998).

2. An observer's brain creates information in the mind

According to Neuroscience, "reportable" and therefore "perceived" information ("conscious" subjective experience) about an external material event in the world or an internal intention is created in one's mind if and only if a neural correlate or neural activity representing the information exists in one's brain (Libet, 1999; Mormann and Koch, 2007). For the experience of observing a material event to occur, the required neural activity is initiated by sensory inputs (material signals). In the case of volitional acts, to know one's own intention, the required neural activity may involve endogenous inputs also. As an example, Figure 1 illustrates how the PI about seeing a book lying on a table is created in the mind of O, who is at rest relative to the table. To every material event P_M reported by a sentient observer O, O's brain goes through a corresponding event BP_M (which can be observed by a monitoring neuroscientist N), namely, completion of the neural correlate of P_M but O's mind reports it as P_M . For example, projection of the sensation of vision out in space, called spatial referral means that we see objects "out there not in here" although images of the objects are actually on the backs of our retinas. The experience appears to us as quite normal!

Note that in Figure 1, O and N agree upon the 'where and when' of P_M using rules of coordinate transformations. *This is true of all material events observed by sentient observers who are at rest relative to one another although the PI created in their brains by the events is not accessible to them or any material device.* In the perception of any conscious observer, material events seem to happen in succession, in a space with three dimensions. Therefore, relativity assumes that space-time (call it R4) consists of a three-dimensional space and a one-dimensional time.

³ There is no 'meaning' or 'real information' also called 'phenomenal information' in any form of pure matter. A word in any language is not identical with its meaning because the same meaning may be conveyed by different words in different languages; we, human beings have assigned meaning to them which is in our heads. Sometimes language is not even used to communicate information. For example, a right signal flashing from a car is an indication to others that it is about to make a right turn. A language is a mapping of information into words (symbols) which become



sound energy when pronounced, particles of matter when written on paper, and become electrical energy when transmitted over a telephone line, and so on. On the other hand, there is 'meaning' or PI in our brains which is different from the language or energy signals that are used for its storage and communication just like water is different from its container without which it cannot be taken from place to place.

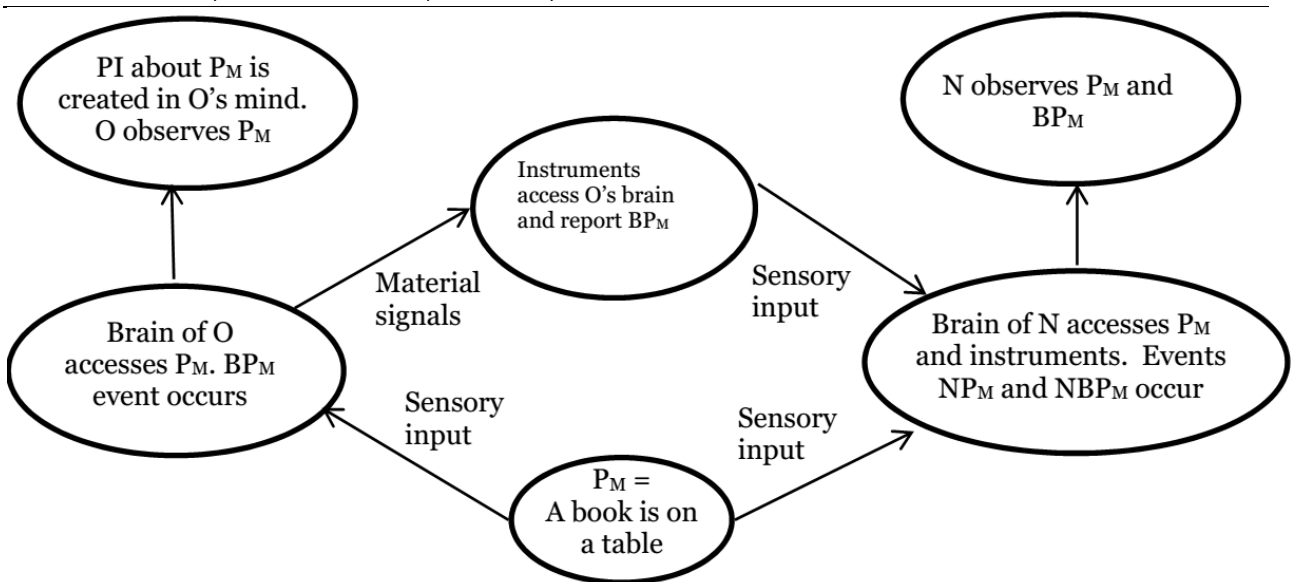


Figure 1. An observer's brain creates information in the mind- seeing the book on the table as an example. O: observer at rest relative to the table, N: neuroscientist at rest relative to O and monitoring O's brain, B_{P_M} and N_{P_M} : completion of neural correlates in O's brain and N's brain upon seeing P_M , $N_{B_{P_M}}$: completion of neural correlate in N's brain upon seeing B_{P_M} report.

3. Applying description of bradyons and tachyons in six-dimensional relativity to matter and phenomenal information subspaces

During the 1970's and later, interest in SR with equal numbers of space and time dimensions⁴ arose for various reasons; some considered 6D-SR as a natural extension of the well-known 4D-SR to make the roles of space and time symmetrical while some others considered that three time dimensions are even essential for consistency of the SR postulates. Since in both special and general relativity all events in space-time are determined once for all, there has been considerable effort to reconcile the probability aspect of quantum mechanics (QM) with the determinism of relativity. Unifying QM and gravity turned out to be even more difficult. Pavšič (1981a) briefly explains how in a higher than four dimensional space-time, one can avoid incompatibility not only between the deterministic relativity and probabilistic QM but also between relativity and the concept of 'free will' or 'free decision'. Considering that 4D-SR does not rule out the existence of tachyons, introduction of three-dimensional time and thereby symmetry between space and time were found to be useful when studying possible

extensions of the Lorentz transformations to frames and objects moving faster than light (see Recami 1986, chapter 14 for a review of various extensions). Although proponents of 6D-SR are not concerned with living matter or with PI, once we identify PI with tachyonic matter, we will find that 6D-SR describes phenomena of matter-and-PI as occupying two different cross-sections of a 6D space-time with three space and three time dimensions.

Clearly, any brain-event is in R_4 but not all brain-events and not all material events create awareness of them in a given observer O's mind. Further, EI- type events are not in R_4 even if they are reportable by O because they are not observable by other conscious beings or material devices by receiving material/energy signals. Thus, matter and PI together seem to exist in a space-time higher dimensional than R_4 . Our assumption that PI consists of tachyons therefore implies that the larger space-time is six-dimensional. Since in our experience, we see and report all material events P_M as happening in succession, we assume:

Postulate of material-event-phenomenal-correlate succession in phenomenal space (PMEPCS): in a sentient observer's phenomenal

⁴ Space and time dimensions are recognized by their sign in the signature of the metric of the space-time.
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space, events other than those of EI-type, which correspond to events in physical space have their time vectors parallel to a single time direction in the 6D space-time.

Postulate of material event succession in physical space (PMES): Time vectors of material events accessed by a subluminal agent (material objects including brains) are all parallel to a single time direction in the 6D space-time.

Since all brain events BP of a given observer O happen in succession as observed by a neuroscientist, from PMES follows that their time vectors are also parallel in the 6D space-time. We make no assumptions about whether EI-type events happen in succession or not.

The six-dimensional pseudo-Euclidean non-compact space-time continuum is defined as the direct sum: $M_6 = T_3 \oplus E_3$, of three-dimensional Euclidean time T_3 and three-dimensional Euclidean space E_3 with metric of signature $(+++---$). In M_6 , an event is given by 6 co-ordinates $(t_1, t_2, t_3, x_1, x_2, x_3) \sim (\mathbf{t}, \mathbf{x})$. The square of the distance between two infinitesimally separated events with the coordinates (\mathbf{t}, \mathbf{x}) and $(\mathbf{t}+d\mathbf{t}, \mathbf{x}+d\mathbf{x})$ is given by the quadratic form:

$$ds^2 = dt^2 - dx^2,$$

where $dt^2 = dt_1^2 + dt_2^2 + dt_3^2$ and $dx^2 = dx_1^2 + dx_2^2 + dx_3^2$. Three types of the quadratic forms are distinguished: (i) $ds^2 = 0$ null distance, (ii) $ds^2 > 0$ time-like distance, (iii) $ds^2 < 0$ space-like distance.

Case (i) is satisfied by the events connected by the light signals with the speed of light being defined as

$$c = (dx^2)^{1/2} / (dt^2)^{1/2} = dx / dt.$$

Case (ii) is satisfied by the events along the world line of a bradyon. Case (iii) is assumed to be satisfied by the events along the world line of a tachyon. With respect to the sign of the quadratic form two classes of transformations are distinguished:

i) subluminal transformations, satisfying $dt'^2 - dx'^2 = dt^2 - dx^2$;

ii) superluminal transformations, satisfying $dt'^2 - dx'^2 = dx^2 - dt^2$.

An object which appears as a bradyon $B = B(F)$ in a frame F , appears as a bradyon $B^* = B(F^*)$ in another frame F^* related to F by a subluminal transformation whereas $B = B(F)$ appears as a tachyon $T = T(F')$ in a frame F' related to F by a superluminal transformation.

The transcendent (infinite relative speed) superluminal transformation relating a material event P_M and its corresponding brain event BP_M :

In earlier work, we showed that the quantum brain creates subjective experience in the form of zero-energy tachyons (ZETs) if the mind consisting of tachyons pays attention to the brain (Hari, 2014). This means that new ZETs are created when the wavefunction collapses; the new ZETs carry information contained in the experience. Hence the coordinates of the observed material event in the rest-frame of any new ZET (as reported by the person having the experience) are obtained from those of the brain's neuronal adequacy event in the rest-frame of the laboratory by the transcendent superluminal Lorentz transformation. This means that in Figure 1, *coordinates of a material event P_M are obtained from BP_M by a superluminal transformation and those of BP_M are obtained from P_M by the inverse superluminal transformation in the 6D-SR.* The Delay and Antedating Paradox (Libet *et al.*, 1979) was resolved using this result (Hari, 2014).

Space-time M_{4B} of physical events of a given subluminal agent:

In tachyon physics, the words "subluminal observer" and "superluminal observer" appear often but they are used without distinguishing between the brain and the mind of an observer. We can apply that theory to PI-and-matter space by replacing the two phrases respectively with "sub/superluminal agent" with the understanding that "observation" in physics implies access by subluminal exchange of energy.

To take into account the fact that our instruments and our brain, when only bradyons are present, do not register the three dimensionality of time, but only of space, one needs to obtain the usual four-dimensional subluminal transformations of coordinates from the six-dimensional coordinate transformations. Pavšič (1981a; 1981b) achieves this by assuming PMES, i.e., a subluminal agent B can subliminally access only those space-time points whose time vectors are parallel to a certain time direction \mathbf{m} in M_6 . He shows that PMES implies that all 6-vectors (events) which are physically accessible to a given subluminal agent B are situated on a four-



dimensional Minkowski sheet M_{4B} embedded in M_6 ($M_{4B} \subset M_6$), and recovers all equations of the usual four-dimensional relativity. The physics on M_{4B} , when only bradyons are considered, is just the usual relativity. All other 6-vectors, not lying on M_{4B} are not accessible to an object on M_{4B} by subluminal exchange of energy.

Space-time M_{4T} of accessible events of a given superluminal agent: Because of the tachyon-bradyon symmetry in extended SR, Pavšič also assumes (without identifying mind with tachyons), that a tachyon T can access by energy exchanges that are subluminal in the rest frame of T (superluminal in the rest frame of B), only those space-time points whose time vectors are parallel to a certain time direction \mathbf{m}' in M_6 . The assumption implies that all 6-vectors accessible to T are situated on a four-dimensional Minkowski sheet $M_{4T} \subset M_6$. It turns out that *the accessible events (space-time points) of a subluminal agent are not the same as the accessible events of a superluminal agent.*

In the above analysis, if we identify the subluminal agent with a particular observer O's brain S and the superluminal agent with a particular tachyon T in O's mind, then the brain-event BP_M corresponding to any material event P_M observable by O is in M_{4S} . According to PMES, one can choose in M_6 , a suitably oriented and translated co-ordinate system F such that a brain-event BP_M (the neuronal adequacy event) has co-ordinates of the form:

$$BP_M(F) : (t_1, 0, 0, x_1, x_2, x_3)$$

where $(t, 0, 0)$ is the vector in T_3 to which all brain-event time vectors are parallel. Now, the transcendent superluminal transformation K transforms the frame F to a frame F' so that the co-ordinates of an event (\mathbf{t}, \mathbf{x}) transform according to (Pavšič, 1981a)

$$K(\mathbf{t}, \mathbf{x}) \rightarrow (\mathbf{t}', \mathbf{x}') = (\mathbf{x}, \mathbf{t})$$

In the superluminal frame F', event BP_M has coordinates:

$$K(BP_M) \rightarrow BP_M(F') : \\ (\mathbf{t}' = (x_1, x_2, x_3), \mathbf{x}' = (t_1, 0, 0))$$

Here, $BP_M(F')$ is not in M_{4S} because the brain cannot access the space-time point $BP_M(F')$ in 6D-space-time by sending/receiving energy subluminaly. For superluminal agents, the vector \mathbf{t}' has the role of the 3-dimensional time. Since it is also assumed (because of the postulate PMEPCS) that a tachyon T accesses only those 6-vectors whose time directions are all parallel in T_3 , T can access $BP_M(F')$ only if $\mathbf{X} = (x_1, x_2, x_3)$ is a time direction accessible to T. If so, $BP_M(F')$ is in M_{4T} . Since $BP_M(F')$ is not in M_{4S} , it follows that events accessible to S and those accessible to T are not the same in M_6 . Moreover, there exist many brain processes which do not create any awareness, and therefore not reported by the sentient observer; such events are in M_{4S} but not in M_{4T} . Thus, the physical space $M_4 = M_{4S}$ and the tachyon space $M_4' = \cup M_{4T}$ of all T in O's mind, are different subspaces in M_6 .

This conclusion is compatible with Smythies' hypothesis that physical world and phenomenal world (even without including EI-type events) contain two different kinds of matter in relative motion and are located in two different cross-sections of a higher dimensional space-time.

However, $M_4 \cap M_4'$ is not empty. If $BP(F)$ is of the form $(r, 0, 0, r, 0, 0)$ then $K(BP) \rightarrow BP(F') : (r, 0, 0, r, 0, 0) = BP(F)$.

Therefore, $BP(F)$ is in M_4 and also in the space M_{4T} of a tachyon T whose accessible time vectors are also parallel to $(t, 0, 0)$. Vectors $(r, 0, 0, r, 0, 0)$ form the boundary between the matter and tachyon spaces where particles travelling with the speed of light live.

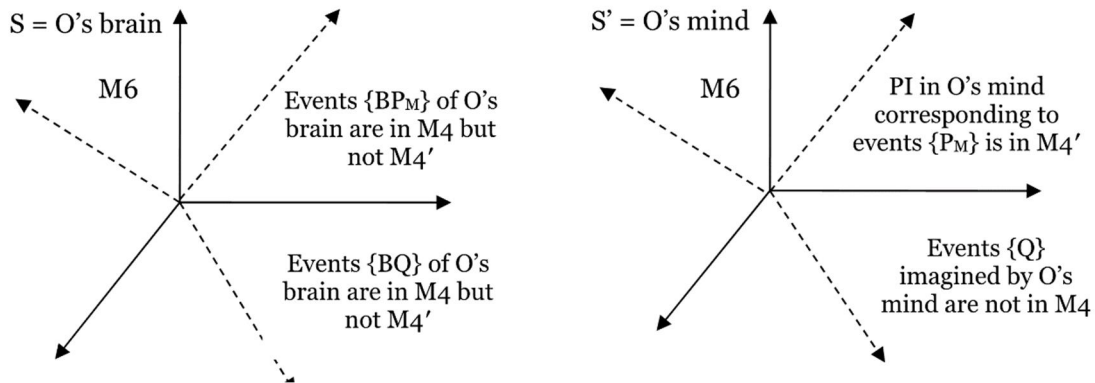


Figure 2. Events observed by the brain and its mind lie on different subspaces of 6D-space-time.

$BP_M \leftrightarrow P_M$: To every material event P_M reported by O, there exists a corresponding neuronal adequacy event BP_M in O's brain S. The neuroscientist N and other subluminal observers who are at rest relative to O (call them the N-team), can observe both BP_M and P_M by receiving sensory or physical signals from them. P_M is in M_4 because S accesses it. BP_M is in M_4 because N reports it. O's mind S' accesses BP_M superluminally; interaction between S' and S creates PI corresponding to P_M in the form of tachyons. $BQ \leftrightarrow Q$: To every event Q imagined by S' which O is aware of, there exists a corresponding material event BQ in O's brain S. S' accesses BQ superluminally resulting in occurrence of Q. N-team observes BQ but not Q. Observer O is 'now' aware of either P_M or Q according as either BP_M or BQ creates PI in S' .

The 'now' of an observation

Consider the neuronal adequacy event BP in the brain S of observer O corresponding to a 'conscious' event P, a material event or of EI-type. If we assume S to be a quantum system, the wavefunction of S undergoes an associated collapse. According to our tachyon theory of the mind, awareness of P occurs because the collapse produces ZETs describing P (Hari, 2011). In the frame F in which S is at rest, according to PMES, the coordinates can be written in the form:

$$BP(F) : (t_{1b}, 0, 0, x_{1b}, x_{2b}, x_{3b})$$

where the space-coordinates (x_{1b}, x_{2b}, x_{3b}) can be taken to be $(0, 0, 0)$ because when one monitors the formation of a neural map, the completed neural map occupies the same place as where there is no such map earlier. The time t_{1b} is the time taken to build the map as measured by the monitoring neuroscientist. In the superluminal frame F' in which the ZETs (in the mind S' of O) are at rest, coordinates of BP are then given by the transcendent superluminal transformation K as follows:

$$K(BP) \rightarrow BP(F') : (t' \sim (0, 0, 0), x' = (t_{1b}, 0, 0)).$$

Thus, O's mind is aware of P at time $t' \sim (0, 0, 0)$, i.e., as happening 'now'.

Therefore, the tachyon theory of mind agrees with Smythies (2003) who says that the experienced 'now' of time in a block Universe is where consciousness is, or the experiencing

subject is but not where his or her physical body and brain are. Further, he says that the present is a moment of physical time fixed by relation to an observing mind and that the observer's mind in a block universe with a shifting 'now' of time must be some entity in addition to the physical body.

PART II

Role of tachyons in voluntary action, conscious will, and brain activity prior to awareness of intention

Baars and Gage (2010) point out that human cognition is forward-looking, proactive rather than reactive and that transition from mostly reactive to mostly proactive behavior is among the central themes of the evolution of the nervous system. We have visions of the future and formulate goals, plans, hopes, and ambitions, all of which pertain to the future and not to the past. Then we act according to our goals but to do so, these mental images of the future must become the content of our memory; thus the 'memories of the future' are formed. The frontal lobes endow the organism with the ability to create neural models as a prerequisite for making things happen, models of something that, as of yet does not exist but which you want to bring into existence.

Some time ago, experiments performed by Libet et.al (1983; 1985) seemed to show that the brain but not our conscious will is what initiates voluntary acts. But our perception is otherwise;



we think that the conscious intention to achieve a desired future state causes us to take the required action, for example, I take a bus to New York (NY) if I want to go to NY. This feeling occurs probably because no required action would be taken if there is no conscious intention to achieve the goal, or if there is a conscious change of mind; moreover, the conscious decision to act does precede the action as verified by Libet's experiments and later by others. When we do perform an action with a purpose or a goal in mind, the result of the action will be most likely, the desired state in the future (unless of course, some external influence prevents the future state from happening) but the action begins in the present. More importantly, the action necessarily depends upon at least some information pertaining to the desired future state, for example, if I want to go to NY I will take a bus to NY but not to Philadelphia. If building the goal record (a neural model of something that, as of yet does not exist) is a prerequisite for the required action to take place, where does the brain get the information about a state in the future? The answer to this question cannot be that all the information comes from the environment and the brain's past memory although for example, when the goal is to reach a visual object, the brain uses inputs from the environment to create a neural correlate (NC) of the goal. The scientist infers from the organism's behavior and location of the NC whether it is a goal or something the organism has only seen but has no desire to reach. So, whatever scientists observe is not what tells the brain to build a model of a future state. The point is that there is no time information in any sensory input received from the environment. Hence the questions: who assigns the label "future" as opposed to "past" or "present" to the neural model? "Who initiates the goal record creation?" are not yet answered. It would be reasonable to assume that the physical brain cannot initiate a new process all by itself (because it would be against the law of causal closure). Even if one argues that the physical brain is a quantum system, and that spontaneous quantum processes such as spontaneous emission happens, such processes happen because of the system being in an unstable state as far as is known. Moreover, the decay phenomenon is irreversible whereas in the case of voluntary actions, one can always have a change of mind until the action has started and even afterwards if the duration of action is long enough. In addition, it seems reasonable to assume that will/volition is not a result of

instability. Even the notion called "downward causation" used to explain emergence and self-organization phenomena of some physical, chemical, and biological systems does not answer the above questions because downward causation is irreversible also.

In what follows, we will consider the question of whether tachyons can inform our subluminal brains about our future without violating causality. If tachyons are able to do so, then our hypothesis that all thoughts including intention and will consist of tachyons implies that unconscious will/volition can initiate a goal achieving process. Indeed, some time ago, physicists Recami (1980) and Pavšič (1981a) answered the question in the affirmative. We will adopt the Pavšič approach that uses extended SR in six dimensions to the brain-mind system, and find that unconscious intention in the form of tachyons can define goals to our brains and direct them to achieve the goals.

1. Tachyons can indeed inform us about an event P^+ with time vector $t^+ = (t_1^+, t_2^+, t_3^+)$ whose length $|t^+|$ is greater than the presently perceptible time t (Pavšič, 1981a)

In the 4D-space-time of the conventional general or special relativity, all world-lines are 'frozen' and strict determinism is valid, there is no room for observer's free decision. This is not so in a higher dimensional space such as M6 in which our space-time R4 is a 4-surface. The succession of brain events BP of an observer O (as seen by a neuroscientist monitoring O's brain) is a progression through M6 of a certain 3-dimensional flat hypersurface E3 of 'simultaneous' events. If one adheres to the classical (non-quantum) physics even in 6D-space-time, then E3 moves forward in a *prescribed* direction in the 3-time. (Similarly, a hypersurface E'3 of a superluminal agent S' moves forward in a prescribed direction in its 3-time which is the 3-space for the brain). But in reality, while O can control some parts of E3 motion consciously (for example, by moving arms and legs), others parts of E3 are not prescribed because O has no control over for example, the weather, accidents, etc. Furthermore, on a sufficiently small scale, the motion of E3 can be subject to unpredictable quantum fluctuations. Assuming that inputs from the environment are not predetermined because of its large number of degrees of freedom, the

progression of E3 is not prescribed for the brain. Each time O decides his/her next move, or O's brain registers a perception about its environment, the brain's wave function collapses giving rise to conscious experience.

E3 motions span a 4-dimensional surface⁵ V4 in the higher dimensional space M6. Since the progression of E3 in M6 is not predictable, the events on V4 are not predictable. At each collapse point, there exist in M6 various possible events and various possible universes V4(1), V4(2), etc. out of which the actual universe V4 containing the actual event BP is just one. Tachyons (the dotted line in Figure 3) can inform O about a future event P1+ on V4(1) by following a time path different from the one in V4(1). O can then decide at BP either to follow the route V4(1) leading to P1+, or to follow some other route, for instance V4(2)⁶. Some of the other possible universes V4(i) of O's subluminal brain may be accessible to O's mind. Denoting the set of all events in M6 which are accessible by the *superluminal* mind as V', O's mind can access simultaneously in 3-time, the cross-sections $V' \cap V4(i)$. In other words, O can imagine some of the possible universes. Tachyons provide a possible way (Figure 3) for a *subluminal* brain to receive information from these other universes which consist of events that are situated outside the particular 4-dimensional space V4. When O receives information about a future event P+ lying on one such V4(i), O can choose to act or not to reach P+; accordingly, O will or will not experience P+ in his/her future, or somebody else may act and cause P+ not to happen before O reaches P+.

Among the inputs to the brain which it uses to create an NC of either a present experience or a future goal, or an EI-type event such as a dream, a neuroscientist can observe mostly those coming from the environment and sometimes from its past memory. In the case of EI-type events and intentional actions, there are inputs to the associated neural activity, which neuroscience does not yet know where they come from. For example, it is not yet known how the readiness potential building process is initiated.

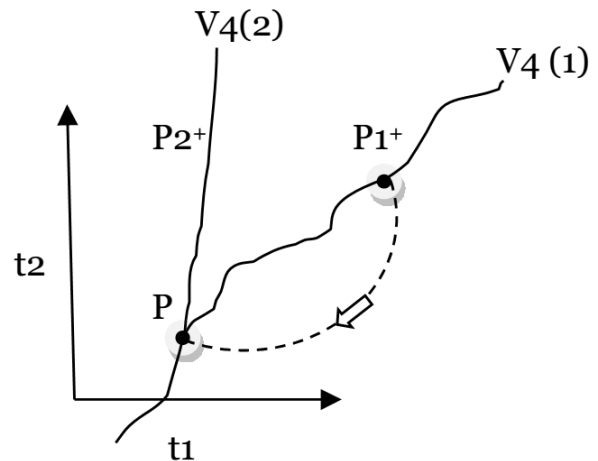


Figure 3. Tachyons can inform us about a future event in 6D-SR.

2. Role of unconscious will

How does the brain/mind make plans for one's own and one's progeny's future? Figure 4 shows the major events or processes that ought to happen when one takes voluntary action to achieve a goal as illustrated by the going-to-NY-by-bus example. These are:

1. The brain needs to acquire information describing the desired future state and then register it, i.e., build a neural correlate of it.
2. The brain needs to build a plan of action; the plan necessarily depends upon the goal information and requires completion of the neural record of the goal.
3. The plan, once figured out should be implemented; the brain needs initiation to do this (because one may figure out what to do but may or may not act upon it).
4. Change of mind can happen; if so there is no further activity related to this goal.

Clearly, the very first step in any goal achieving process is the first process in the above list. Hence the question arises where does the brain get the information about a possible future state of itself? Can a material system ever know what its future state would be or decide what its future state should be? Neuroscientists Addis et al. (2007), for example, find evidence of activity in right frontopolar cortex and left ventrolateral prefrontal cortex when one imagines future events; they think that engagement of the right

⁵ If E3 motion fluctuates, then the corresponding 4-dimensional continuum described by the progression of E3 is a curved space but not a flat one.



⁶ Thus causality paradoxes of tachyons are resolved because they are all essentially due to the possibility of receiving information from the future by means of modulated tachyon beams along V4(1).

hippocampus in future event construction is possibly a response to the novelty of these events. Here, the novelty which the brain recognizes cannot simply be that the information it has just received is not already there in its memory; the brain probably recognizes that the input from imagination is not all sensory as usual.

As shown in Figure 4, the second item in the list above follows the first. The third event in the list, namely, a trigger to implement the plan of action can enter the brain any time after the NC of the goal is completed but action can begin only after the plan of action is completed. This trigger is required because, action need not begin as soon as the plan is completed and may not even happen due to a change of mind or due to external circumstances. Change of mind can happen any time after one is aware of one's own intention, will, desire, purpose, etc. before action starts. There is evidence in neuroscience for this functional sequence. The readiness potential (RP) observed in experiments related to voluntary acts seems to consist of the NC of the goal and that of the appropriate action plan. Haggard (2001) suggests that Lateralized Readiness Potential which

consists of later parts of RP may indicate that the intention has progressed from abstract stage –“Do something or other!” to drive a specific movement –“Do precisely this!”

Thus the questions: “how does the brain acquire in its present memory, information regarding a possible future physical state of itself, “who initiates the goal record creation, and “who initiates action?” are answered as follows: Tachyons coming from a *possible* future state (for example the event P2⁺ in the 6D-space-time of Figure 3) can convey to the brain what its future should be and also trigger both the goal building and action-plan building processes. The intention which initiates the brain to build the NC of the goal remains unconscious until the brain completes the NC because both the intention and its NC are required for awareness. Similarly, change of mind is a tachyon coming from the predetermined future state P1⁺ in Figure 3. This simply tells the brain to reject the earlier NC and the partial or completed plan of action it has already built. Awareness of the change-of-mind arises immediately because this trigger does not require building new NCs but only stop further work.

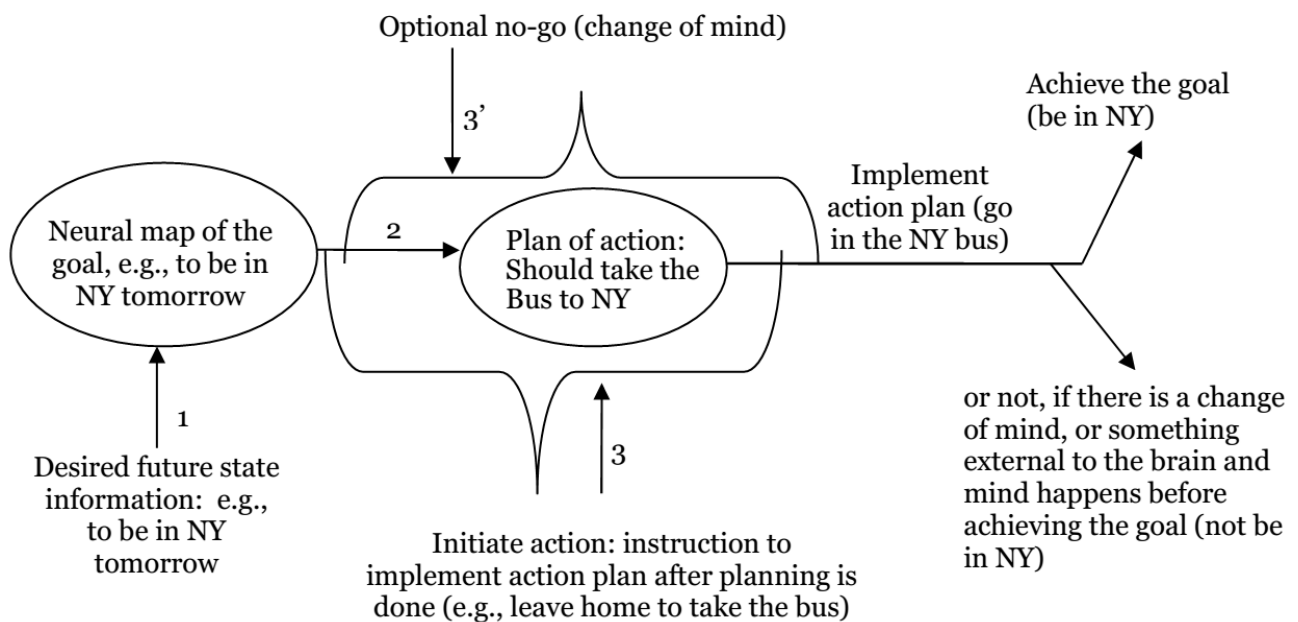


Figure 4. Functional flow in a goal achieving or volitional activity (future state realization).

Conclusion and outlook

The tachyon theory of mind in the space-time of the extended SR with three space and three time dimensions shows that tachyons can pass possible-future-state information to an observer's brain without violating causality and thus explains

why an unconscious readiness potential precedes the conscious intention to perform a volitional or goal-oriented act. Thereby the theory suggests the presence of unconscious thought. Our theory of mind satisfies the need for Special Relativity with extra time dimensions expressed by the modern



neuroscientist John R Smythies in his theory of Material Dualism. His proposal that the physical world and the phenomenal world contain two different kinds of matter in relative motion and are located in two different cross-sections of a space-time with higher-than-four dimensions turns out to be a conclusion of our theory.

In our analysis we stated that an observed material event P_M and its corresponding brain event BP_M are related by a transcendent (infinite relative speed) superluminal transformation. It should be possible to test this rule experimentally because the observer can report the coordinates

of P_M and the neuroscientist monitoring the observer's brain can measure the coordinates of both P_M and BP_M . Such a test would not only verify the validity of our hypothesis that the mind consists of tachyons but also indirectly verify the existence of tachyons!

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References

- Addis DR, Wong AT, Schacter DL. Remembering the past and imagining the future: common and distinct neural substrates during event construction and elaboration. *Neuropsychologia* 2007; 45(7): 1363-1377.
- Bilaniuk OMP, Deshpande VK, Sudarshan ECG. Meta Relativity. *Am J Phys* 1962; 30: 718-723.
- Baars BJ, Gage NM. *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience*. Academic Press, 2010.
- Carr B. A proposed New Paradigm for Matter, Mind and Spirit. *Network Review Summer 2010*; 3. <https://www.scimednet.org/sites/default/files/private/networkreviews/103/article1-bernard.pdf> Accessed date: January 8, 2016.
- Feinberg G. Possibility of Faster-Than-Light Particles. *Phys Rev* 1967; 159(5): 1089-1100.
- Haggard P, Libet B. Conscious Intention and Brain Activity. *Journal of Consciousness Studies* 2001; 8(11): 47-63.
- Hari SD. Mind and Tachyons: How Tachyon Changes Quantum Potential and Brain Creates Mind. *NeuroQuantology* 2011; 9(2): 255-270.
- Hari SD. Mind and Tachyons: Quantum interactive dualism - Libet's causal anomalies. *NeuroQuantology* 2014; 12(2): 247-261.
- Libet B, Wright EW, Feinstein B, Pearl DK. Subjective Referral of the Timing for a Conscious Sensory Experience. *Brain* 1979; 102: 193-224.
- Libet B, Gleason CA, Wright EW, Pearl DK. Time of conscious intention to act in relation to onset of cerebral activity (readiness potential). The unconscious initiation of a freely voluntary act. *Brain* 1983; 106: 623-642.
- Libet B. Unconscious cerebral initiative and the role of conscious will in voluntary action. *The Behavioral and Brain Sciences* 1985; 8: 529-566.
- Libet B. How does conscious experience arise? The neural time factor. *Brain Research Bulletin* 1999; 50(5/6): 339-340.
- Mormann F, Koch C. Neural correlates of consciousness. *Scholarpedia* 2007; 2(12): 1740. http://www.scholarpedia.org/article/Neural_correlates_of_consciousness Accessed date: January 10, 2016.
- Pavšič M. Towards Understanding Quantum Mechanics, General Relativity and the Tachyonic Causality Paradoxes. *Lettere al Nuovo Cimento* 1981a; 30(4): 111-115.
- Pavšič M. Unified kinematics of bradyons and tachyons in six-dimensional space-time. *J Phys A Math Gen* 1981b; 14: 3217-3228.
- Recami E. Classical tachyons and possible applications. *Rivista Del Nuovo Cimento* 1986; 9(6), 1-178.
- Smythies J. Brain and Consciousness: The Ghost in the Machines. *Journal of Scientific Exploration* 2009; 23 (1): 37-50.
- Smythies J. Space, Time and Consciousness. *Journal of Consciousness Studies* 2003; 10(3): 47-56.
- Smythies J. Many Mansions: Special Relativity, Higher-Dimensional Space, Neuroscience, Consciousness and Time. *Cosmology* 2014; 18: 110-118.
- Wolf FA. The Timing of Conscious Experience. *Journal of Scientific Exploration* 1998; 12(4): 511-542.