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Why is "Consciousness" Still a "Hard Problem"

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ABSTRACT

There are some problems which are defying a solution from time immemorial. Researchers and thinkers are not able to find their solutions.

Does life continue after death? Does Consciousness outlive death? We do not have its answer because to learn the answer one has to die and since ticket is one way, he can't come back and tell the answer. Hence the paradox which makes the query a hard nut to crack.

Similarly, the question "What is Consciousness" is defying a solution and is called a "Hard Problem". While in Coma we are unconscious and doctors are unable to predict when consciousness will return to the patient because no one knows how consciousness manifests. The question again suffers from a paradox--- to learn the answer one has to be conscious and once you are conscious you have already missed the chance of learning causal aspects of consciousness.

This vital question is considered 'A Hard Problem" and scientists and philosophers the world over are trying to find a solution to the hard problem. To date, no one has succeeded in explaining consciousness accurately.

This paper tries to explore why it is so difficult to solve the 'hard problem'

Keywords: *Consciousness, Hard Problem, Coma state, conscious state of mind, causal reasons behind manifestation of consciousness, what is consciousness*

Philosophers across the world fell in line behind David Chalmers (A philosopher from Australia) when he called "Consciousness" a "Hard Problem in the conference- "The Science of Consciousness" held in Tucson, Arizona in 1994.

The following year, the main talking points of Chalmers' talk were published in *The Journal of Consciousness Studies*. The publication gained significant attention from consciousness researchers and became the subject of a special volume of the journal, which was later published into a book. In 1996, Chalmers published *The Conscious Mind*, a book-length treatment of the hard problem, in which he elaborated on his core arguments and responded to counterarguments. (*https://en.wikipedia.org/wiki/Hard_problem_of_consciousness*)

Many thinkers tried to explore Consciousness but to date, no one has been able to solve the Hard Problem.

Consciousness brings awareness about the environment and makes us active and aware about ourselves and the surrounding environment but when consciousness is gone, we become inert and lifeless. When in a coma, we are without consciousness; only our automated parts like our heart and lungs keep functioning and doctors don't declare us dead. They can't tell when we shall come back to life i.e., regain consciousness because they know nothing about consciousness. They do not know from where it comes and how. It is observable that we do breathe and our heart does beat while we are in a coma but do we perceive through senses is not known. Maybe we hear things while in a coma; maybe our thought process is working and we are thinking but unable to express our thoughts. Our motor action is stopped but maybe mentally we are active. Whatever is happening within us, for the world, we have lost consciousness and no one knows when the consciousness will return.

We know neurons fire in the brain and we do things but we hardly know what activates the neurons and how. It is as if someone switches on the light and neurons in the brain start firing and awareness fills the brain. The question is why even after so much advance in science, we are still unable to understand consciousness.

This paper tries to explore this question!!

Consciousness was the topic where Papers were read at a seminar[1] at Ramakrishna Mission Institute of Culture. Kolkata, India, on 16,17 and 18 January 2004 and some lectures captured thoughts of thinkers on why Consciousness is eluding an explanation.

In the next paragraphs, I discuss the thoughts presented in those lectures and try to deduce why Consciousness is a hard problem:

In the lecture, "***Consciousness-The Unanswered Questions"*** P.N.Tandon gives the following views of some thinkers and scientists:

Defining Consciousness accurately is extremely difficult lying on the verge of impossibility. The great nineteenth-century neurophysiologist Emil Du-Bois-Reymond declared the scientific exploration of consciousness impossible.

While Reymond asserted that consciousness cannot be explained scientifically, he did not elaborate on reasons. Sperry does bring out some reasons why it is impossible to understand 'Consciousness"

As late as 1960, Sperry, a Noble Laureate stated 'We were having problems with understanding consciousness because the inner sensations, feelings, concepts, mental images, and the like cannot be weighed, measured, photographed, or Spectro graphed, or chromatographed, or otherwise recorded or dealt with objectively by any known scientific methodology.

Consciousness cannot be explained because its artefacts - *the inner sensations, feelings, concepts, and mental images* cannot be evaluated or formulated in any physical manner, say, by weighing/ measuring/ photographing / or recording etc…

Since we cannot project mental images, thoughts or inner sensations on external screens, consciousness has been a hard problem. Maybe in times to come there will be advancement in science and we shall be able to project the images of thoughts/ inner feelings on external screens and that may give a breakthrough in the understanding of Consciousness.

In fact, it is said that Nikola Tesla, a great physicist was toying with the idea that thoughts and inner feelings do project images on our retina and it should be possible to project them on an external screen. He was working on a project called 'Thought Projector' but before he could make a breakthrough in it, he passed away.

Smith[2] in his paper, ***"Nikola Tesla's wildest Project------Thought Projector",*** mentions "When Nikola Tesla died, he left behind fascinating writings about inventions he never realized. One such invention is ***DER GEDANKENPROJEKTOR,*** a camera that could be used to photograph thoughts."

Tesla (1933) argued that if it be true that thought reflects an image on the retina, it is merely a question of illuminating the same properly and taking photographs & then using ordinary methods which are available to project images on the screen.

"If this could be done then the objects imagined by a person would be clearly reflected on the screen as and when they are formed, and, in this way, each thought of the individual could be read. Our minds would then be "***Open books"***

Tesla's line of research is an extension of the fact that things don't need to be seen only with open eyes, one could, even, see things with closed eyes; the only difference will be that the objects to be perceived are not external but within the self --- i.e., images, instead of coming from the open eye, these can come directly to the retina as reflex images from thoughts created by the mind and the rest of perception activities in the brain can continue as they do normally.

Tesla's thinking seems to be credible; thoughts, by reflex actions, must be producing images on the retina, how else could we see dreams??

Dreams may be thoughts portrayed as motion pictures which get reflected on the retina and through the normal processes of these getting converted into electrical impulses passing on information to neurons and synapses to make us see them as movies while asleep.

Tesla's plans never became a reality but researchers are still studying ***vision*** and exploring the idea of building mind-reading machines.

Possibly a breakthrough in projecting thoughts and inner feelings on an external camera may open up a way to understand consciousness.

Coming back to P.N.Tandon's collection of thinker's thoughts on consciousness:

In 1975, Dr Wilder Penfield summarizing his life-long experience with exploring the human brain was forced to conclude, 'From my part after striving to explain the mind based on brain action alone, I have concluded that it is simpler (and far easier to be logical) that one adopts a hypothesis that our being consists of two fundamental elements-the brain and mind.

John Eccles, (1977) another Noble Laureate, in his book co-authored with K R Popper, The Self and the Brain, acknowledged, 'Hitherto it has been impossible to develop any neurophysiological theory that explains how a diversity of brain events come to be synthesized so that there is a unified conscious experience of a global or gestalt character.

As per Eccles and Popper, it has so far been impossible to correlate neural activities to causal aspects of consciousness. Another view, as we shall see in the below paragraph, supports a view that consciousness is beyond space and time and hence unexplainable:

G Wald (1979) another Noble Laureate in his address on 'Life and Mind in the Universe' argued that consciousness is not a part of the universe of space and time, of observable and measurable quantity that is amenable to scientific investigation.

The idea that Consciousness transcends from somewhere not in this universe of space and time makes it a very complicated phenomenon.

Crick and Koch (1992) Had already proposed that 'all aspects of mind including its most puzzling attributes consciousness and awareness – are likely to be explainable in a more materialistic way as the behaviour of large sets of interacting neurons.

Even though we are far from understanding and explaining Consciousness, scientists, now feel that the study of consciousness (or mind) is not impervious to science.

Now we can say that there is enough evidence to state that the brain plays an important role in the maintenance and manifestation of consciousness. The above developments made Patricia Smith Churchland (1999) claim, 'Neuroscience can reveal the physical mechanisms subserving psychological functions… that awareness is some pattern of activity in Neurons'.

Neuroscience today knows how the brain processes vision, hearing, memory and emotions but does not know what it is like to remember or feel happy or sad. The knowledge of the brain thus does not seem to yield complete knowledge of conscious experience. This is what philosophers like David Chalmers call a 'Hard Problem' of consciousness i.e., the questions of how physical processes in the brain give rise to subjective experience.

The above paragraph gives a very plausible logic as to why Consciousness is eluding an explanation. While the brain functioning explains all five senses-seeing, hearing, smelling tasting and feeling through neural activities but can't explain conscious feelings like memory, and feeling happy/sad. Neurons fire and perception happen but what makes neurons active and why the neuron firing can't create conscious feelings is still not known. There must be some button, till that button is pressed neuronal activities do not start. Once the neural activities start, we can explain all human behaviour through the firing of neurons.

What is that button?

The following paragraph indicates the area where this button could be located but then we get stuck on further explanation and have to take shelter of mind and mental faculties which could trigger consciousness in that area of the brain:

British Noble Laureate John Eccles got the Nobel Prize in 1963 for his pioneering research on the synapses in the brain. He recently announced that he can even specify in which precise location the interaction between consciousness and matter takes place in the brain.

*The region of the brain about which Eccles speaks is known as the supplementary motor area or SMA. It is located at the top of the brain. SMA was first discovered by Wilder Penfield in the 1920s. How does SMA work? Neurophysiologists Robert Porter and Coble Brinkman surgically implanted micro-electrodes in the SMA region of monkeys. These monkeys were taught to pull a lever to get their food. But it was discovered that one-tenth of a second before the monkeys pulled the lever, the brain really started to work and the cells in the region of SMA began to fire and direct the motor nerves for action. Consciousness first sparked in the SMA and then only the body began to work. Eccles also discovered that the early burst of discharge in SMA was not due to stimulation by another cell in the SMA region or elsewhere in the brain. He concluded that '**We have an irrefutable demonstration that a mental act of intention initiates the burst of discharge of a nerve cell**' Eccles told Parapsychologists ' the mind manages to move the atoms of oxygen, hydrogen, carbon and other particles in the brain cells' Eccles believes that it is by a ' Complex code that the non-physical mind is actually playing the 50 million or so neurons in the SMA region.*

How and when did this non-physical mind come to function on our body? Eccles believes that it entered our physical brain during embryological development and thus according to Eccles it is conceivable that such a non-physical self might also survive the death of our physical body and brain.

Thus, Consciousness first sparks in the SMA and then only the body begins to work. The early burst of discharge in SMA is not due to stimulation by another cell in the SMA region or elsewhere in the brain. How then the neurons get stimulation? The only answer could be that a mental act of intention initiates the burst of discharge of a nerve cell. Thus, the mental intent makes consciousness enter the brain and stimulate the brain cells and then neurons start firing and body motor actions result.

The insight into the brain leaves the question unanswered and still consciousness is the Hard Problem.

In the series of lectures, Prof E.C.G.Sundarshan talks about *Life, Mind and Consciousness:*

The matter of consciousness is very subtle and elusive more than the mind. Is it identical to life itself? Is it a faculty of life to have consciousness? Or is consciousness pertaining to another domain?

An important question is whether consciousness must necessarily be associated with a living body. Can There be a disembodied consciousness which at its will, chooses to associate with a body and a life? Are the body and/ or the life aspects of the consciousness? Is it that consciousness can use an embodied form and at other times be disembodied?

The question, naturally, is raised: why the self should incarnate, and become entangled, with the physical world and life? One answer is that it only appears to do so but does not change. The other is that there was the intentionality (sankalpa) of acting out a play (Leela). ***But these are difficult questions towards which physicists can only grope.***

Here also the view that intent or thoughts may cause consciousness prevails but no explanation is forthcoming about what the consciousness is. But what are thoughts? Are thoughts things?

Prof. Leonard Clark Johnson seems to agree with this and reports experiments which support his theory.:

A report of remote non-local influence in human neurophysiology published by Grinberg-Zylberbaum, Delaflor, Attie and Goswami in Physics Essays volume 7, pp422-428 in 1994 has stimulated a lot of interest in the field of consciousness science.

The results of this study appear to indicate that neural events (evoked potentials) in one human brain produced by visual stimulation to a single human subject can induce similar visual evoked potential EVP in the brain of another person located several meters away who is not visually stimulated. They conducted several experiments to replicate these findings.

These experiments use several measurement modalities (e.g., EEG and fMRI), and have been designed and executed using experimental and statistical methods specifically designed for this research question. Using these techniques we have identified individuals whose brains consistently respond to stimulations being experienced by a distant partner.

Two of the seven pairs tested showed a 'Transferred EEG potential'. This concludes that neural events from one human brain can be transferred to another human brain without biological contact.

Scientists all over the world are trying to replicate the above results and several have succeeded. Dean Radin of the Institute for Noetic Sciences has focused on the exploration of nonlocal interactions among people and has reported a study replicating the above results.

The results are astounding and are being interpreted differently.

Perhaps Thoughts are things—The Western model of sensory perception and conscious experience anticipates a neurological response to externally presented stimuli. For example when we repeatedly place an object in a person's visual field we expect to find reproducible responses in the brain. We assume this works because:

- *The perceived object has substance (e.g., it exists and has properties we can measure)*
- *A mechanism of information transfer is possible*
- *Humans have an organ through which they can sense the flow of information*
- *This information is aggregated at some level of 'awareness' in the brain.*

In the above experiments, we seem to be observing the aggregation (e.g., step 4). If we accept these results and hold onto our above basic model of how perception works, then we may be obligated to draw surprising inferences. Since all perceptual phenomena in our experience are predicated upon the unambiguous existence of the above first three factors, is it then reasonable to use the dominant paradigm and infer that this experimental manipulation is generating some kind of 'Object'? Could thoughts be things or objects?

It could be a startling revelation. If thoughts are things i.e., they are physical materials and they trigger brain neurons to fire; maybe consciousness is also physical.

We come back to Tesla's thought projector. If thoughts were physical things, it should not be impossible to project them to an external screen from the mental images which get formed when thoughts manifest. Thought Projectors once become a reality, we may be close to the truth behind the phenomenon of 'Consciousness'.

The above paragraphs capture the well-considered analysis of the question-"Why is consciousness a hard problem" by the participants in the seminar. Summarizing their thoughts, we can say that:

One view is that consciousness may reside in the brain and is located in the supplementary motor area (SMA) which is located at the top of the brain. After the spark, the body begins to work. But what causes the spark and how is not known. The early burst of discharge in SMA is not due to stimulation by another cell in the SMA region or elsewhere in the brain. Thus, we do not what causes the spark. A view is that a mental act of intention initiates the burst of discharge of a nerve cell. Thus, the mental intent makes consciousness enter the brain and stimulate the brain cells and then neurons start firing and body motor actions result.

Many speakers agreed that thought or mental intent may be the cause of consciousness but how it happens is still not known. Since we cannot project mental images, thoughts or inner sensations on external screens, consciousness has been a hard problem.

Experimental studies indicate that the thoughts or mental intent could be things. If thoughts are things i.e., they are physical materials and they trigger brain neurons to fire; maybe consciousness is also physical and since they could be physical, it should be possible to project them on external screens.

Maybe in times to come there will be advancement in science and we shall be able to project the images of thoughts/ inner feelings on external screens and that may give a breakthrough in the understanding of Consciousness.

It is said that Nikola Tesla, a great physicist was toying with the idea that thoughts and inner feelings do project images on our retina and it should be possible to project them on an external screen. He was working on a project called 'Thought Projector' but before he could make a breakthrough in it, he passed away.

Another school of thought is that the consciousness may not reside in the brain.

Noble Laureate G Wald's' idea that Consciousness transcends from somewhere not in this universe of space and time makes it a very complicated phenomenon. If it does not reside in the brain and transcends from outside, it must not be affected by death and consciousness may outlive death. Maybe that's why we have life after death. If that be the case, the hard problem becomes more complicated.

So above are the conclusions drawn (which still fall short of explaining the Hard Problem) from the lecture series.

Let us now explore what other researchers have to say on the subject:

Philip Goff[3] posits:

Consciousness can't be directly observed, if you are dealing with another human being, you can ask them what they're feeling, or look for external indications of consciousness and if you scan their brain at the same time, you can try to match up the brain activity, which you can observe, with the invisible consciousness, which you can't. The trouble is there are inevitably multiple ways of interpreting such data. This leads to wildly different theories as to where consciousness resides in the brain. Believe it or not, the debates we are currently having in the science of consciousness closely resemble debates that were raging in the 19th century.

Goff tends to feel that consciousness cannot be observed but it may be residing in the brain, a view that is not agreed by many thinkers as is evident in the thinking provided in the lecture delivered at the Calcutta conference-

A very recent report of medical research by a British Scientist studying heart-attack patients was presented recently (June 2001) to a group of scientists at the California Institute of Technology, USA, and its report states as follows ***' a well-structured, lucid thought process with reasoning and memory formation work in human beings at a time when their brains are shown not to function. The possibility is certainly there to suggest that consciousness, or the soul, keeps thinking and reasoning even if a person's heart has stopped, he is not breathing and his brain activity is nil'*** *The report is based on a year-long study.*

The above research presents a startling fact that the brain may have nothing to do with Consciousness and since consciousness may be entering the body from an external environment, it may not reside even in the body, it can outlive life and may exist even after death in a form still unknown; or for that matter we even do not know its form even while we are alive.

Consciousness continues without the brain or heart is confirmed through research by Wilder Penfield, the great Canadian neurosurgeon who admitted after 20 years of his experiments that consciousness and mind are not in the central cortex. *Penfield wrote about the patient's reactions during brain surgery: 'The patient's mind, which is considering the situation in such an aloof and critical manner, can only be something quite apart from neuronal reflex action. And yet Mind seems to act independently of the brain in the same sense that a programmer acts independently of his computer, however much he may depend upon the action of the computer for a certain purpose. 'Though consciousness is the essential condition for all sciences, science cannot deal with it… Consciousness itself lies outside the parameters of space and time that would make it accessible to science. Consciousness cannot be located. But more, it has no location. Penfield's teacher Sir Charles Sherrington wrote: 'Mind, meaning by that thoughts, memory, feelings, reasoning and so on is difficult to bring into the class of physical things. Physiology, a natural science, tends to be silent about all outside the physical. The interface of Physics with Biology: New Biotonic laws are required to explain organizational complexities.*

Consciousness which seems to have a direct correlation with thoughts is claimed to be non-physical by Penfield and his teacher. This idea could be disproved if scientists can find ways and means to project thoughts on an external screen as per the ideas of Nikola Tesla which we discussed earlier in the paper. And if it happens then physicality will be established and we should, then, be able to crack the hard problem of Consciousness.

Physicist Wigner has other ideas about consciousness. He thinks that consciousness could be an energy field. Let us explore his ideas:

Noble Physicist Wigner speaks of his firm conviction of the existence of Biotonic laws. He asks, 'Does the human body deviate from the laws of physics as gleaned from the study of inanimate matter?' Wigner argues that the laws that guide the growth and evolution of living organisms are different from the laws of physics of matter.

Consciousness is being realized now as a field with significant properties such as interconnectivity, integration, multidimensional projection, and super-positioning; such a field is visualized as an Energy field.

The brain has around one hundred billion neurons which can generate and do generate electromagnetic fields for transmission or local interaction between neurons through various electrical and chemical processes within the brain inspired by ***thoughts****.*

In the field of consciousness within and outside the brain, there is transmission and communication of energy. A living body with a functional consciousness assimilates energy from the environment.

Consciousness creates a complex energy field, complex enough to be explained by science and still more difficult to understand. Through consciousness, we can reach any distance at any time. The well-recognized property of an electromagnetic field is that a field moves as a wave outward from the source, and moves outward with time. 'The molecular energy is converted into the energy of an external electromagnetic field.

This view also suggests that brain activities are propelled by intention or thoughts because the local interaction between neurons through various electrical and chemical processes happening within the brain are inspired by thoughts. Thus, the view that thought or intent is the thing which triggers the firing of neurons is confirmed by this physicist. He goes on to say that consciousness is an energy field which could reside in the brain or outside and gets energy from the environment. This energy comprises particles other than electrons, protons or photons which are neutral in nature. He calls them Neutrinos. Neutrinos are electrically neutral, have zero charge, and are not subject to strong nuclear force. They pass through anything and everything instantaneously and without any resistance without the barriers or limitations of space-time. This may account for the unobstructed flow of our consciousness beyond the space-time barrier. To fully understand consciousness, this energy field needs to be understood in more detail as to what constitutes it, where exactly it resides and how it manifests.

Mark Solms[3] does not consider 'Consciousness' a physical entity. He explains that we are going on the wrong path in understanding consciousness when we ask only which brain processes *correlate* with consciousness, not how they *cause* it. The hard part of the problem is this: "How (and why) do these physiological processes produce a conscious state of mind?"

There are two reasons why we have failed to solve the hard part of the problem. The first is philosophical and the second is scientific.

The Philosophical view is that Physiological processes do not produce consciousness in the sense that the liver produces bile. Consciousness is not a thing but a point of view. What we perceive objectively as physiological processes in the brain, we perceive subjectively as conscious states.

What I can make out of the above statement is that sometimes we look at things but don't really see them. Objectively the physiological visual perception process has happened but subjective experience did not happen and hence we could not experience the objects which were in view. So there could be visual perception objectively but the subjective view would be the conscious state of seeing. Visual perception could create two states i.e., one where the visual perception has happened following the visual perception process using the retina etc… but we have not observed the things which came into our view. In another situation, a conscious state is created and we really see things. The process is the same, one is objective and the other subjective. The question is how that conscious state gets created. The philosophical view falls short of explaining the phenomenon of Consciousness.

Coming to the scientific view, Solms continues to say:

We have been focusing on the wrong brain function as our model example, namely visual perception. Visual perceptual processes are not intrinsically conscious. We know from tachistoscopic experiments, for example, that it is possible to read with comprehension and to recognize familiar faces (both of which are cortical processes) and to respond to these stimuli accordingly, without awareness of having seen anything. That is why Chalmers can assert that complete knowledge of how the brain processes visual information fails to explain why we have visual experience; it is perfectly possible to see without having the experience of seeing.

However, this does not apply to another, more promising brain function, namely affect— or at least to the aspect of affect that we call 'feeling'. How can you generate a feeling without feeling it? This is not a linguistic issue. Whether you feel something or not makes a difference to what you ***do****.*

Unlike reading and face recognition, which can occur unconsciously, feeling something has different causal consequences from not feeling it.

If you do not feel hungry, energy metabolism proceeds autonomously. However, when you do feel it you are motivated to look for food and to eat.

The same applies to all other felt affects. If you are objectively in danger, for example, you do not run and hide unless you become aware of the danger, and you feel scared.

Affects are generated not in the cortex but in the brainstem. Accordingly, children who are born without a cortex, in hydranencephaly, are conscious and emotionally responsive. That is why deep brain stimulation of some brainstem structures – especially the periaqueductal grey (PAG) and reticular activating system (RAS) – produce intense affects within seconds, and that is why most psychiatric medications act on the neuromodulatory systems that are sourced in the reticular activating system. Most important is that tiny lesions in the brainstem (as small as 2 mm3) obliterate all consciousness, including visual consciousness.

These facts suggest that the fundamental type of consciousness is affect and that it is generated not in the cortex but in the brainstem. The sentient subject is literally constituted by affect, and we only become conscious of our visual (and other) cortical processing when it is 'palpated' by these brainstem neuromodulator systems.

The views posted by the author assert that feelings do not have relevance to the brain because the 'affect" leading to feelings is triggered in the brain stem. But the hard problem of consciousness still remains, only it does assume a new form, namely: "How and why do feelings arise?

We have examined various theories trying to explain consciousness but the discussions would be incomplete without discussing Integrated Information Theory (IIT) projected by Giulio Tononi[4]. We shall conclude this paper after exploring this theory.

Hedda Hassel Mørch[5] has detailed information about this theory:

Consciousness is something with which we're all intimately familiar. It's the thing that goes away every night in deep sleep and comes back when we wake up every morning, or whenever we start dreaming. It encompasses all our subjective feelings and experiences, ranging from the simple redness of red to the complex depth of emotion to the ephemeral quality of thought. It's the one thing that is directly and immediately known to us and mediates our knowledge of the external world.

Giulio Tononi's Information Integration Theory (IIT) tries to define systems that could be conscious. IIT has three components-

- Availability of information about itself
- Integration of available information
- Maximum quantity of integrated information

The above three components are adequately explained by Hedda Hassel Mørch[5]:

Systems that have Information about themselves

Information is contained by a book but it does not talk about itself, whereas information in the brain is about its own functioning. That's why the book is not a conscious system but the brain is.

According to IIT, the only kind of information that matters for consciousness is the information a system has about itself. Not only this but this information must be based on the system's causal powers.

Thus, the information must not be only about itself but the information must be based on the system's causal powers i.e., we must be able to assess how much can we know about the previous and next state of the system by looking at the state of the system right now. The brain as a system qualifies this definition.

The current state of a typical human brain can tell us a lot about what that brain looked like a moment ago, and what it will look like in the next moment. There are a limited number of previous brain states that could possibly have caused its current state, and a limited number of future brain states that it could possibly cause.

However other parts of the body do not satisfy this definition. Say, Retina--- By looking at the current state of the retina, we learn a lot about what the environment in front of the retina was like a moment ago. We also learn about the next state of the visual processing system that takes input from the retina. But we don't learn much about the past and future states of the retina itself, because they are nearly completely fixed by the external environment – very little is left to be determined by the retina itself. This gives the retina very little information in IIT's sense.

Integration of information in the system

Integration measures how much the information of a system depends on the interconnections between the system's parts. To determine it we ask: how much information is lost by cutting the system in two?

Information in a page of a book is not lost if we cut the page into two pages—information remains intact even though now it is in two pages.

But the information in a part of a brain is totally lost if the part of the brain is cut. In the brain, in the areas relevant for our consciousness, every neuron is connected to thousands of other neurons, to form amazingly intricate structures. If the brain is cut in two, much of this structure would be lost, along with the information that depends on it. Any disconnected state will imply a very different past and future of the brain than an intact state would. This shows that the brain is a highly integrated system.

Maximality of integrated information in a system

IIT's third and final requirement is that a conscious system must be a maximum of integrated information. That is to say, it must have more integrated information than any overlapping system, including its own parts and any bigger system of which it itself forms a part.

For example, the area of the brain that directly supports our consciousness – the latest studies suggest some areas of the posterior cortex – must have higher integrated information Φ than any smaller neuron groups, individual neurons, molecules, and atoms that form part of it. It must also have higher Φ than the brain as a whole, the human body, human societies, the internet, and any other bigger system of which it forms a part, all the way up to the cosmos itself.

This implies that If some smaller group of neurons within a larger brain area that normally supports consciousness suddenly became significantly more interconnected, and thereby surpassed the Φ of the larger area, then this smaller group would form its own consciousness separate from the larger whole. Or if the Φ of a normally conscious area suddenly dropped below the Φ of all smaller neuron groups at some level, its consciousness would dissolve into multiple lesser consciousnesses belonging to these neuron groups individually. Indeed, this could be what happens temporarily, in deep sleep: we think consciousness entirely disappears, but it might actually just change into a fragmented form (which is no longer recognizable as 'our' consciousness).

These three components in the brain correlate with consciousness and hence make the brain a most conscious system.

Having understood the three needed components of a system that are needed for Information Integration theory, we come to explore this theory:

Information Integration theory

IIT (Information Integration theory) *says that consciousness is linked to integrated information, which can be represented by a precise mathematical quantity called Φ ('phi'). The human brain (or the part of it that supports our consciousness) has very high Φ, and is therefore highly conscious: it has highly complex and meaningful experiences. Systems with a low Φ, the theory goes, have a small amount of consciousness – they only have very simple and rudimentary experiences. Systems with zero Φ are not conscious at all.*

According to IIT, the only kind of information that matters for consciousness is the information a system has about itself. This information must be based on the system's causal powers, not on symbolic conventions.

To measure information of this kind, we ask: how much can we know about the previous and next state of the system by looking at the state of the system right now?

How much information a system has about itself also depends on its number of possible states. A simple photodiode, that can be either on or off, can have very little information about itself, as its present state could rule out only one out of two possible states, at most. In contrast, the brain consists of billions of neurons, and there are endlessly many different combinations of neurons firing and not firing that is possible given most sensory, bodily and other

background conditions. But knowledge of the current state of the brain rules out most of them: only a few of these combinations could have caused the current combination, and there are only a few combinations it could cause. This gives the brain very high information about itself.

IIT implies that most animals probably are conscious. Most animal brains appear to be highly integrated. Going down the ladder of organic complexity, Φ, and consciousness, gradually decreases, but it never completely fades out. Even bacteria have a small amount of consciousness because cells and organelles are integrated systems too. Plants, on the other hand, are probably not conscious, because individual plant cells can be estimated to have higher Φ than the plant as a whole.

As per IIT, the brain has maximal integrated information and hence as per IIT, the brain possesses High phi value and is ***Highly Conscious.***

The theory does attempt to define a ***conscious system*** and thus makes an attempt to understand consciousness and does succeed partially but it does not explain it fully. IIT says that only those systems with maximal Φ are conscious. Consciousness, according to IIT, is a matter of balance. On the one hand, it requires complexity and variation as conditions for high information. On the other, it requires unity and integration – the parts of a conscious system must be more strongly connected to each other than they are to anything else.

We may know whether a system is conscious if we know that it has a high value of Φ but there is also what is known as the *hard problem*: Why is consciousness correlated with any physical states at all? How does any physical state give rise to subjective experience? The results are promising, yet inconclusive. But if the theory does turn out to be on the right track, it has deep and radical implications for the place of consciousness in the natural order.

With a detailed exploration of the reasons for consciousness being a hard problem, we approach the end of this paper. Most thinkers have felt that since science deals only with physical things and since consciousness is non-physical we cannot explain consciousness scientifically. On the other hand, there have been attempts to prove that consciousness is indeed a thing and hence it is physical so it must be possible to find its explanation but still, we are stuck up and cannot explain how consciousness manifests. There is a school of thought that intent or thought triggers consciousness which when manifested, makes neurons active in the brain and brain functions make us active and aware. This school of thought further affirms that thoughts create images at our retina and there must be a way to project these images on an external screen and once we are able to do this, we shall find a clue to the mystery of consciousness because thoughts or intents trigger consciousness. Worldwide researchers are attempting to develop thought projectors or are in the process of algorithms to externally project thoughts as pictures. Once science advances to that stage, some clues to understanding consciousness will surface up.

The concept of consciousness being systems that have high values of integrated information also may lead to some clues to the exact meaning of consciousness. Penetrative Research is the need of the hour.

Lastly, I wish to state that Consciousness is the aware state of life but it could also outlive life and life after death manifests due to latent consciousness which is alive after we die. We have not understood whether life exists after death because we have not understood 'Consciousness'.

We are unable to explain whether life exists after death because the ticket is one way, we die and cannot come back to tell the story as to whether and how we became conscious after we died. Some thinkers say that consciousness survives death. We do not know whether it is true because firstly we do not know what consciousness is in the first place.

The consciousness is slightly more complicated than that of life after death because while unlike life after death, we do come back from Coma (an unconscious state) and gain consciousness; but we still do not know how it happened. We come back alive from a Coma but do not know what made consciousness return to our body which was lying inert, and hence, we are as ignorant about consciousness as we are ignorant about life existing after death.

I conclude the paper with a conscious observation that understanding the consciousness is probably ***paradoxical****. The paradox is that to understand consciousness you have to be conscious. Still, since the time taken to become conscious is less than the time to understand its process, you miss the opportunity to understand it. We always miss the phase of understanding the conscious process because of the above paradox. The paradox is the basic reason behind the mystery of the hard problem evading solution.*

But there has to be a way—there was a paradox as to how could brain research the functioning of the brain. But brain research has happened. Maybe in future, there will be a similar breakthrough in consciousness research. We hope it happens during our lifetime!!

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