Consciousness, Experience and Ways of Knowing

Editor
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NATIONAL INSTITUTE OF ADVANCED STUDIES
Bangalore, India

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Perspectives from Science, Philosophy & the Arts

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Editor's Note

This volume is the proceedings of the National Conference on "Consciousness, Experience and Ways of Knowing: Perspectives from Science, Philosophy and the Arts" held at the National Institute for Advanced Studies, Bangalore from 6-7 February 2006. Many distinguished scientists, philosophers and artists spoke at the conference. The invited speakers included Mrinalini Sarabhai, B. V. Sreekantan, K. Ramakrishna Rao, S. Mahadevan, Sumantra Chattarji, Shatavadhani R. Ganesh, C. S. Unnikrishnan, Nataraja Sarma, M. Srinivasan, R. L. Kapur, Narayanan Srinivasan and Sharada Srinivasan. A hundred people, including scholars, students, engineers, doctors, et al. attended the conference. Dr. K. Kasturirangan, Director of NIAS gave the welcome and opening remarks. The Conference ended with a panel discussion. We thank all the speakers who not only took the time to come to the conference and speak but also to send in their papers for this volume in time. Our sincere thanks to the *Global Perspectives on Science and Spirituality Award Program* (jointly managed by the Interdisciplinary University of Paris, France, and Elon University USA, with funding from the John Templeton Foundation) for facilitating this conference. The Conference was made a lively and engaging event with the participation of several registered participants who came not only from Bangalore but also other cities of India. Thanks to Ms. V. B. Mariyammal for assisting in organizing the conference and bringing the book to this final shape.

Sangeetha Menon
27 June 2006

Opening Remarks

K. KASTURIRANGAN
Director, National Institute of Advanced Studies, Bangalore.

I welcome all distinguished speakers and participants to this two-day National Conference on "Consciousness, Experience and Ways of Knowing: Perspectives from Science, Philosophy and the Arts".

Along with nanotechnology, biotechnology and information technology, brain studies is considered to revolutionize human experience in the coming decades. The last few decades have seen tremendous achievements in not only creating new technologies and theories to understand life, nature and the universe, but also have brought back the human factor into discussions like never before.

Consciousness studies is one area that has emerged as a significant one in bringing disciplines together and redefining the basic questions we ask with an emphasis on the role of experience. Today the significant role of interdisciplinarity in understanding the various facets of the human mind and brain encourages scholars to sit together and churn the foundational structures of their questions and methods.

The limits of ways of knowing seem to extend with new insights into the complex nature of the human mind. The divide between the two cultures is no more a definite and rigid one. The erstwhile strict quantitative neural approaches today give significant place for more qualitative ideas on agency, memory, aesthetic experience and so on. Some time back in his famous Reith lectures to the BBC, the noted neuroscientist Dr. Vilayanur S. Ramachandran, Director of the Centre for Brain and Cognition at the University of California in San Diego, said that the solution to the problem of aesthetics lies in a more thorough understanding of the connections between the thirty visual centers in your brain and the emotional limbic structures. According to him, once we have achieved a clear understanding of these two connections, we will be closer to bridging the huge gulf that separates C. P. Snow's two cultures - science on the one hand, arts, philosophy and the humanities on the other. With more of these connections getting a clear place in the way we present knowledge systems, we could be at the dawn of a new age where specialization becomes old-fashioned and a new twenty-first century version of the Renaissance man is born.

This two-day conference will present varied approaches to understand, appreciate and learn from basic human experiences with focus on specific theories of knowledge and method. The questions and issues that will be raised will include the nature of reality according to science in the light of understanding consciousness, the neurobiology of memory, the theory and experience of rasa and beauty in Indian aesthetics, consciousness and cognitive anomalies, brain and meditative experiences, the importance of experience in the world of science, etc.

I welcome all of you to this exciting conference on Consciousness, Experience and Ways of Knowing. I thank the eminent scholars who have come from Bangalore and outside and agreed to speak to all of us. I am sure that this conference would be a very fruitful one and an interesting one and in Sangeetha's words, "Let a million ideas bloom". But I would like to cut down the million to a thousand, being a scientist. Thank you.

Introduction

SANGEETHA MENON
Fellow, National Institute of Advanced Studies, Bangalore.

Today often the issue that gathers focus inspite of its evasive nature, in discussions on consciousness, cognition, or even advancements in nanotechnology and biotechnology, is about *Experience* with a capital 'E'. The last few decades have seen tremendous achievements in not only creating new technologies and theories to understand life, nature and universe, but also have brought back the human factor into discussions.

Consciousness studies is one area that has emerged a significant one in bringing disciplines together as well as posing the challenge of the 'binding problem' of subjective experience. The puzzle how neural, discrete and quantitative processes give rise to consciousness that is subjective, unitary and qualitative has expanded the domain of consciousness studies to include as many different forms of human experience and ways of knowing.

Do experience and the way we understand have significant roles in altering our ideas about consciousness? This is one question, which we would explore in this two-day conference.

According to Thomas Kuhn, the late historian and philosopher of science, much of what we learn, including science, is by example. When we learn by example, we learn how to do something, not necessarily knowing everything that is involved in doing it. This kind of knowing was termed tacit knowledge by Michael Polanyi, where we do not fully know what it is that we know.

So, is knowledge tentative and related to how far we extend our paradigms? Is the concept of 'what is knowledge' quite different in the sciences, humanities and arts? What is the role of experience in influencing knowledge systems? These questions will be recurring today and tomorrow.

Another interesting phenomenon is about the theory of emergence. Considering the inherent non-reducibility in theory of emergence how do we understand a complex phenomenon? The theory of emergence emphasizes that the phenomenon of emergent order deals with organization, with the higher levels showing new properties that are not evident at the lower levels. The unique properties and behavior of complex systems arise from how the parts are arranged and interact. These properties and behavior cannot be fully explained by breaking that order down into its component parts. Considering this inherent non-reducibility, how do we understand a complex phenomenon like consciousness and subjective experience? What is complexity?

This conference will address the persistent puzzles and attempted solutions in consciousness studies, developments in cognitive sciences, and the distinct ways of knowing and experiencing in science, philosophy and the arts in the context of the Indian discourse. It is hoped that such a discussion will help to examine the emerging trends in these areas and also explore the place of 'experience' in knowledge systems.

The Concept of Beauty in Indian Aesthetics

MRINALINI SARABHAI
Darpana, Ahmedabad.

In every aspect of Indian classical tradition, the beauty of the human being has been compared to the elements of nature. An exquisite love scene from the Tamil epic *Shilappadikaram* speaks of the hero Kovalan's first night with his beloved Kannaki.

The scene was "as if the sun and moon had together bathed the entire world clasped by the sea in their light. He wore a wreath of jasmines in bloom....her's was a garland of shimmering red and purple water lilies...." Kovalan addresses his beloved :

> "Dear Kannaki, wasn't the moon born with you when it became your forehead, and Kama the shadowy god of love pledged his lofty sugarcane bow to you when it became your two dark eyebrows. Eclipsed by your beauty the bejeweled peacock which hides itself in the fresh woods, helpless before your elegant step, the swan vanishes into a field of limpid water."

The association of the birds, the animals, the universal features of the forest glades to human beauty and energy, is symbolic of India's close affiliation with nature. The moon gave the radiance to the face of the beloved, the eyes resembled the deer or like the Goddess Meenakshi, the shape of the fish. When the bee hovers around Shakuntala in Kalidasa's immortal classic *Shakuntala* the King Dushyanta remarks :

> "Again and again you touch her quivering eyes with their tremulous corners having beside her ear you hum sweetly as though whispering a secret, though she moves her hand, you drink the nectar of her lower lip the essence of joy – O bee you are indeed blessed!"

The bee has always held a special place in people's heart – perhaps not only for the precious honey, but also revered as a protector. Vishnu in the Rig Veda is often symbolized as a blue coloured bee resting on a lotus, and Kamadeva's bow has the string fashioned from a cluster of bees.

In the philosophical text *Saundaryalahari* by Sankaracharya, which extols the beauty of Devi in ecstatic terms, the poet writes:

> "With naturally curly locks as beautiful as young bees encircling it your face shames the beauty of the lotus.
>
> When your eyebrows are slightly arched, O you who are devoted to banishing the fear of the worlds... the beauty of your limbs is like paths of splendor from the fresh sun strung with your two eyes, which are like bees...."

While bees represented signs of love hovering around the beloved, the swan or *hamsa* was a messenger. In the story of Nala and Damayanti, it is a swan that carries the message of love and acts as go-between.

The story is very beautiful. King Nala of Nishada, wanted to seek the hand of the Vidarbha Princess Draupadi who was courted even by the Gods. From his palace he sends a swan to woo her and Damayanti is captivated. The great artist Ravi Varma, whose paintings are some of the most exquisite in the world of art has pictured the heroine Damayanti with the swan, in one of his beautiful portrayals of women.

A moving scene tells us of Damayanti capturing the golden swan. The swan led her to a secluded part of the garden, and she almost fainted when it placed its white head almost caressing her and spoke :

> "O princess Damayanti, there is a king named Nala who has no peer among men. In my wanderings I have seen no one equal to Nala and his energy is like the ceaseless flow of the Ganga river."

Through the swan's words, Damayanti falls in love with the Nishada king.

When the marriage was celebrated, the beautiful palace was decorated with images of nature. In a multitude of colour the queen of the Nagas rising from Patala was depicted. At the top of the pillar was a picture exquisitely drawn of Garuda. The brocade hangings were patterned with images of birds set with emeralds, rubies and pearls. The garments of the women looked like white moonlight, the colour of jasmine flowers, and emeralds like the green of young bamboos.

Damayanti, gorgeously dressed, looked exquisite. As Nala entered the room, her dark eyes like deep pools shone in the moonlight and as she smiled, her teeth were white as cammrinle petals.

Nature in Sanskrit poetry encourages lovers and helps them to meet together. A leaf is a letter Sakuntala writes to the king. Many manuscripts were written on palm leaves and exist even today. The *Natyasastra* of Bharata was a valuable treatise on palm leaves. In Orissa this tradition still continues for manuscripts and paintings.

In the play Vikram and Urvashi, the Vidusaka tells the king Vikrama :

"The bower of *Atimukta* creepers has a seat to receive you having dropped flowers because of the black bees clashing against them. Sitting here you may forget your longing for the beautiful Urvashi."

In all our ancient stories poetry, music and dance forms, nature plays an important part. After a dance performance, apart from the golden coins, the dancers received a crown of green leaves as related in the Tamil classic *Shilappadikaram.*

An ancient story of the origin of music tells us of the great sage Svati. The great sage Svati once went to collect water at a pond. Large raindrops driven by the wind struck the lotus leaves. He saw and heard the *nada* went back to his hermitage and contemplated the creation of sounds on an earthen pot.

Great kings had as their emblems tigers and lions adored on their flags. Tamil poetry pays homage to the elements in songs of praise. An ancient song describes :

"Let us bless the Moon, let us bless the Moon
like an umbrella of pollen laden flowers
it covers and cools the earth with light

Let us bless the Sun, we bless the Sun
eternal traveler around the goldern mount Meru
a symbol of the loved king of the lord of the Cauveri river

We bless the Rain, we bless the Rain
pouring from on high, generous as the Ruler
of the Earth surrounded by the Sea, ever benign."

Throughout Indian literature, nature has been an important aspect of all artistic heritage of the deep spiritual insight. Rishis meditated under trees and great sages like the Buddha received enlightenment while searching for Truth under the Bodhi tree.

An interesting episode about how trees are cut and made into images with deep reverence is related in the *Bhavishya Purana* when Narada muni speaks:

"O thou tree, salutations!
Thou art selected to be
carved into this second image
Please accept this offering.
May all the spirits residing in
this tree, transfer their habitation
elsewhere after accepting the
offering made according to our ruler.
May they pardon me today
For disturbing them."

Love poems to Krishna dominate Indian literature and dance. Jayadeva's *Geeta Govindam* is known throughout India and one instance of Krishna's words to Radha, depicts the great affiliation of art to nature's beauty.

Krishna, the Beloved Blue God appeals to his beloved in eloquent terms:

"Your moist lips glow
Like crimson *bandhuka* blossoms
Your tender cheeks, like pale *madhuka* petals.
Angry Radha! Your eyes defeat
The dark blue lotuses in beauty
Your nose is a sesame flower
Your teeth are white jasmine.
Availing of the beauty of your face
Love's flower arrows conquer worlds."

Science, Reality and Consciousness

B. V. SREEKANTAN
National Institute of Advanced Studies, Bangalore.

The original purpose of science was essentially to understand what is happening around us and how to interpret them in terms of as few hypotheses as possible. Knowledge for the sake of knowledge was the original aim of science and all the applications came in spite of pursuing science with this objective.

Charles Townes, the Nobel laureate gives this definition for 'science': "Science is the attempt to understand the structure of the universe and how it works, including ourselves. Religion is the attempt to understand the purpose and meaning of the universe including ourselves".

Of course, George Bernard Shaw always had his own way of saying: "Science is always wrong. It never solves a problem without raising more problems".

And Popper says: "Science is a process of problem solving and explanation seeking".

Of the many definitions of science some are purely for the sake of knowledge, and the other go into technology, applications etc. I will concentrate essentially on what science has done about explanation of the universe.

Purpose of Knowledge

The origin of the universe is fixed at 13.6 billion years. If you go back in time and ask the question what the universe was at various times, the picture is very different from what it is today. Today, there are so many billions of people on the earth. There was a time when there was no human being on the earth. There was a time when there was no life on the earth. Even the earth was not there some five billion years ago. If you ask the question 'what is really reality', then you have to immediately ask another question to what point of time you are referring to. Because reality itself, in a sense, has changed, unless you define reality in such a way that it is something which doesn't change. What is it that we look for when we ask the question, 'what is reality'?

Reality is different at different levels, particularly in the reductionist approach. For a chemist it is enough to know up to about molecules or so. Nothing beyond molecules is relevant for him. He can do all his chemistry. A biologist also can go up to the molecule, stop there and then essentially do 90 to 95% of his biology. He does not have to bother anything beyond. But, on the other hand, if you go to a physicist, he has to go further down and worry about atoms and structure of the atoms, the nuclei, structure of nuclei, the structure of fundamental particles and so on. The question of reality is a question of 'for whom' and 'who is addressing that question'. It is not something which is the same for everybody. Philosophically you may say, that there is only one kind of reality, that is absolute reality. The question is what is absolute reality? Is there one? And if it is so, what is the use of it, as far as we are concerned? Supposing there is something which is there, and which you can't access, which you can't describe and which we don't know when it was created. The question that follows is what is the use of it, from any point of view, except from the point of view, of one who just wants to know the ultimate truth for the sake of knowing it. It has absolutely no use as far as many of us are concerned, neither in normal life nor in the academic life. When the question of reality arises what matters is its purpose.

Symbols and Correlations

There are various ways of approaching this question. Let us take a simple example of looking at, say, a rose flower. When I look at it, two things happen. One is what happens in the mind. There is a distinct perception and recognition of the flower. Then, of course, immediately you recognize its smell, colour, softness, symmetry, beauty of the flower. You may also recall some associations with the rose. That means, memory is immediately triggered. How does all this happen? What is the scientist's explanation of it?

The scientist wants to relate mind and consciousness to the activity of the brain. What is it that is registered in the brain? What happens in the brain is: first the retinal image is activated - the rods and cones in the eye - and then generation of action potentials. These are electrical potentials that are triggered. They are all of practically the same duration and the same amplitude. But depending on what the scenario is, what the details are, the relative frequencies of triggering of action potentials changes and these potentials are transmitted through the millions of neurons to particular areas of the cortices of the brain. Vision is connected with the visual cortex. Millions of neurons are connected from the eye to the visual vortex. In passing through each single neuron the pulse has to encounter enormous amount of obstructions. It has to go through what are called synapses. In the synapses, the electrical signals stop, a neurotransmitter chemical is released. Again this neurotransmitter chemical passes through some distance in the synapse. Whether the pulse should be sent forward or stopped is decided by other neurons that are there by the side. What should happen in each synapse is determined not only by one particular neuron but also by the associated neurons in the neighbourhood and sometimes the synapse is quite far off also. Finally, the bundle of electrical signals go to the cortex and more neurotransmitter chemicals are released. That is all that we know from all the developments in neurosciences. We have to relate the release of these neurotransmitter chemicals and electrical pulses to what we call consciousness, namely the softness of the petal, the color of the flower or the smell of the flower. All that we find is some kind of correlations. Various kinds of tomographs, scanning instruments and the laser instruments give us these correlations.

In the whole of science we establish nothing but correlations. For example, we use mathematical symbols in equations and relate them to what is happening elsewhere. If you want to study the planetary motions, you reduce them to the equations of Newton, work out the consequences and then predict. In all these we work through the symbols. In fact, for the sake of mathematics, we can even represent the entire sun by one point and the entire earth by another point. Mathematics takes over the functioning of prediction and we completely lose sight of what is happening physically there. It becomes much more complicated when we go into more subtle phenomena that we encounter in the field of quantum mechanics. For example, in the case of radioactivity, the alpha particle is inside the nucleus and later on it is outside. Though we record registration of an alpha particle outside, there is no way we can construct its trajectory. As science advances, we find that it becomes a representation of one set of quantities by another set of quantities. This is where consciousness plays an extremely important role. We can see that ultimately it is consciousness that is transforming signals into something that is qualitative. Without consciousness, you appreciate none of these. There is no smell; there is no color, there is nothing.

The Imperceptible Substratum and Nothingness

Einstein says, "Matter, when we perceive, is merely nothing but a great concentration of energy in very small regions. We may therefore regard matter as being constituted of space in which the field is extremely intense. Field is the only reality". We start with very concrete matter. We think we understand what matter is and how matter is converted into various forms. But, ultimately, reality according to Einstein, is just field. What is the field? We just can't imagine it because we can only give a mathematical definition. Because there is no longer a physical entity which we can identity as field. The whole role reverses. And finally we start thinking of matter in terms of field and its manifestations.

Dirac says all matter is created out of some imperceptible substratum, which is nothingness according to him. Nothingness is ultimately what we call quantum mechanical vacuum. Reality is only quantum mechanical vacuum and fluctuations of it - either spontaneous fluctuations or something you bring about by deposition of energy, and that is responsible for creation. Nothingness according to Dirac is unimaginable, and undetectable. But it is a peculiar form of nothingness out of which all matter is created. Ultimately, we come to a situation where what we thought we would be able to concretize, ends in being reduced to symbols.

Weinberg says that the present level of understanding seems to be all about elementary quantum fields. They are very simple because they are governed by symmetries. They are not objects with which we are familiar. In fact, our ordinary intuitive notions of space, time, causation, substance and so on lose meaning in that scale. We want to know something much more substantial. But we end up in things that we have to only postulate.

To his amazement Bohm found that, once they were in a plasma, electrons stopped behaving like individuals and started behaving as if they were part of a larger and interconnected whole. Although their individual movements appeared random, vast numbers of electrons were able to produce effects that were surprisingly well organized. Like some amoebic creature the plasma constantly regenerated itself and enclosed all impurities in a wall in the same way that biological organisms might encase a foreign substance in a cyst. This brings up another important aspect of the way things happen, i.e. individual behavior and collective behavior are very different. We cannot on the basis of individual behavior predict what is going to happen collectively. As a matter of fact, the whole field of emergence, which is today becoming one of the important areas of investigation, is just that you cannot predict what happens. In as much as in social sciences you cannot predict crowd behavior by studying individuals. Many phenomena are happening because of the collective action of many individual entities resulting in coherence effects and emergence. What Bohm says is that even electrons lose their identity once they are in the company of other electrons and you cannot predict their behaviour.

When a physicist looks at quantum reality or relativistic reality, he is not looking at things in themselves – noumenon – a direct and non-mediated reality. Rather, the physicist is looking at nothing but a set of abstract differential equations, not a reality itself but a mathematical symbol of reality. Heisenberg says, "It is important to realize that the behavior of smallest particles cannot be described unambiguously in ordinary language. The language of mathematics is still adequate for a clear cut account of what is going on". But the question really is: Is that the kind of reality we are looking for?

The Subjective and the Objective

Schrödinger, the author of the famous book, which inspired many scientists to become biologists, said, "The scientific picture of the world around me is very deficient. It gives a lot of information, puts all our experience in a magnificently consistent order but it is grossly silent about all and sundry, that is really near to our heart, that really matter to us. It cannot tell us a word about red and blue, bitter and sweet, physical pain and physical delight; it knows nothing about beautiful and ugly, good or bad, god and eternity. Science sometimes pretends to answer questions in that domain, but answers are very often so silly that we are not inclined to take them seriously. In brief, we do not belong to the material world that science constructs for us. We are not in it. We are outside it. Because it is the criterion of objectivity that we use in science. We take out subjectivity and then try to explain everything in terms of what we call objective reality."

Schrödinger continues: "We are only spectators. The reason why we believe that we are in it, that we belong to that picture is because our bodies are in that picture, our bodies belong to it. Not only my own body, those of my friends, also of my dog and cat and house and all other people and animals. And this is the only means of communicating with them. Moreover, my body is implied in quite a few of more interesting changes, movements that go on in this material world and is implied in such a way that I feel myself partly the author of these goings-on. But then comes the impasse, this very embarrassing discovery of science that I am not needed as an author. Within the scientific world picture all these happenings take care of themselves. They are amply accounted for by direct energy interplay. Even the human body movements are its own, as Sherrington puts it. "The scientific world picture vouches a very complete understanding of all that happens. It makes it a little too understandable. It allows you to imagine the total display as that of a mechanical clockwork, which, for all that science knows, could go on just the same, as if it does without there being consciousness, will, endeavor, pain, delight and the responsibility connected with it, though they actually are. This is the kind of situation in which we are. We want answers to these questions but science is not able to answer them and the reason for this disconcerting situation is just this - that for the purpose of constructing the picture of the external world, we have used the great simplifying device of cutting our own personality out, removing it, hence it is gone, it has evaporated. It is ostensibly not needed. In particular, and most importantly, this is the reason why the worldview contains of itself no ethical values, no aesthetic values, not a word about our own ultimate scope or destination, no God, if you please, whence I came, whither I go. Science cannot tell us a word about why music delights us or why and how an old song moves us to tears. Science, in principle, describes in full detail all that happens in the latter case, i.e. why tears come to our eyes, in our sensorium and motorium from the moment the waves of compression and dilatation reach our ear to the moment when certain glands secrete a salty fluid that emerges from our eyes, but of the feelings of delight and sorrow that accompany the process science is ignorant and therefore reticent".

Schrödinger wrote this nearly fifty years ago. More recently Francis Crick came up with his famous hypothesis that all our joys, all our sorrow, etc is nothing but the neurons being activated. There is nothing else other than the play of neurons that are responsible for all the emotions. He wrote this in *The Astonishing Hypothesis.* The hypothesis was that there is nothing else other than the activity of the neurons to explain everything. After two hundred and sixty-five pages of this beautifully written book, he comes to the very strange conclusion that this hypothesis may be right or it may be totally wrong; there may be some other religious or other explanation.

Nature controls everything. That is what Einstein calls – 'cosmic religion'. Einstein comes to the conclusion that just by randomness and chaos operating all this can not happen. What he says is that there is a cosmic intelligence. But we should make a difference between a personal god and the cosmic intelligence.

What is the methodology of science? The methodology of science is to understand all phenomena in terms of, constituents and the forces. There may be alternative methods, for example, somebody might say I will understand it by just contemplation or meditation.

Those are different from science. The methodology that we have adopted so far in the field of science is by the method of trying to correlate one thing to the other and trying to find out what is the cause, what is the effect up to the level we can proced. For example, in the last fifty years the advent of all different kinds of tomographic instruments has given us much more insight into what is happening inside the brain, and neurons. This is the power of technology. But ultimately it has not given the answer we are looking for. When you consider the question of ultimate realities, the ultimate truths, we find that science is in an impasse.

In Popper and Eccles' book *The Self and Its Brain* two positions are taken. One is a deterministic evolution: It was predetermined that human beings will come into this earth and have consciousness and so on. But there is another aspect, probability, chance and uncertainty, which make the evolution of a system somewhat contingent on different parameters.

Whatever approach you take finally you are not getting a right answer.

It is all right to talk in terms of generalities. When we go into details of mechanism we find that there is no adequate answer. That has been the problem with science also. We all use Newton's laws for nearly three hundred years. We all assumed Newton's laws and then did so many calculations, without understanding the fundamental question how the force acted at a distance. When somebody asked Newton, how the force acted at a distance, he said, "God only knows". At the same time you can't question the validity of Newton's laws, or the usefulness of Newton's laws. In our way to analyze these fundamental problems we end up with the feeling that science is prepared for changes. That is the strength of science.

There is no doubt that a lot of effort is going on in the field of science, particularly in the field of biological sciences to understand many of the intricacies of life, consciousness etc. and to find out what the ultimate realities are. But, ultimately, we end up in a situation where science is not giving the answers that you would like to have for the most fundamental questions. In fact, Schrödinger says that when I do something, say I lift my finger, there is a will on my part that is responsible for it. We cannot say just the atoms in my brain are responsible for it.

We ask the question, what is the 'I' that is there? When I say, "I do it", "I will", etc. The question is, "What is this I?" Schrödinger says: The only possible inference is that 'I', in the widest meaning of the word, is to say every conscious mind that ever said or felt "I" am the person, if any, who controls the "motion of atoms" according to the Laws of Nature. This insight is not new. The earliest records date back to some two thousand five hundred years or more, from the early Upanishads. The recognition Atman equals Brahman - the personal self equals the omnipresent, all-comprehending eternal self – is an Indian thought considered far from being blasphemous to represent the quintessence of deepest insights into the happenings of the world. Schrödinger came to this conclusion nearly fifty to sixty years ago, long before the developments that have taken place in many sciences. In fact, in the last fifty or sixty years, the developments in science are fantastic. There is absolutely no question about it. But none of the developments, as far as I can make out, have made any dent in changing the final outcome of the conclusions to which some of these scholars of the pre-1950 days had come. Eddington, Max Planck, most of them who are Nobel laureates who have written on this subject, became a kind of 'mystics'. They are all, after all, scientists who really developed science. They were driven to some kind of mysticism because in their serious attempts at understanding what is happening they ended up being mystics, throwing up their hands and saying that as far as the ultimate reality is concerned, we have to say that there is something beyond science. While science is certainly contributing quite a lot to our stream of knowledge, we should not forget that science is one of the many streams that are there. Science is just one of the streams that contributes to the knowledge and has been, of course, of great value in improving life in so many respects.

For example, the average life of an Indian has gone up from thirty years to seventy years or so and you can straightaway attribute it to the benefits of science. There is no question about it. But at the same time, when we ask the question – about ultimate realities and insights, we have no option but to keep our minds very open.

Denying Experience in the Physical World: Consciousness Misled

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Human consciousness is perhaps the only subject of study that has attracted serious attention, as a topic of thought and discussion, of people in all walks of life. This is perhaps because everybody has something to say about 'It', rightly, from experience. The vastness of the possibilities of speculations has also brought in considerable amount of mysticism, glorification, trivialization etc. into the literature on consciousness studies, along with some insights. Indeed, we usually see samples of all these in conferences on topics related to consciousness studies. The individual or the collective human consciousness itself has no innate way of determining whether statements on its properties and abilities are true, false, or irrelevant. Indeed, even at a more primary level, it has no innate ability to decide which of a set of linguistic statements about the plausible truths in the physical universe is a true statement. The topic of this paper is this serious and crucial inability of the complex entity called consciousness and some of its consequences in seeking knowledge. I will use some examples from history and from the present situation in physical sciences to illustrate the central point.

Experience plays a very important role in seeking and gaining knowledge. When situations are designed specifically to gain experience, we are talking about experiments. Recognizing the conceptual implications of empirical experiences require a high level of awareness and feel for the physical universe and its behaviour. I will explore how collective objective scientific knowledge of our times could be grossly off the mark because of the denial of experience and of the results of experiments in particular. Such situations arise in the physical sciences due to efficient biasing of scientists' collective consciousness, generally thought to be immune to such bias, by specificities of theoretical descriptions, as well as due to factors of sociology, politics and even religion.

We usually assume that the ability to do logical reasoning and analysis is innate to human beings. As a starting point one may accept that for some reason human beings are able to use logic in a simple and natural way according to certain rules of reasoning that seems acceptable to most people. In occasions when logic is used, it also seems that gross misunderstanding about natural phenomena is avoided and the scientific rationality based on logic and experience forms the basis of communication and consensus in scientific activity. Its methods as well as practice depend a lot on the assumption of universal classical logic, and there is no reason yet to doubt the validity of this approach. But it seems that this operates at a layer that could be veiled by more subjective considerations, as we will soon see.

The progress of science or of any pursuit of seeking knowledge is actually hampered by the inability of the conscious mind to judge, in a pure and a priori manner, without depending on previous experience of the material world, whether something that is presented to it as a fact or law of nature is truth or not. At least to some people this might come as a surprise, especially if they believe that there is something supernatural and super-material about consciousness. Here I am using the word 'truth' in a material physical sense, as represented in a fact that can be experimentally checked, under some approximations and within the limitations and the resolutions of the senses or instruments. Schools of natural philosophy that advocate that truths can be reached by pure thinking, without relation to observations of the behaviour of the external world, also will object to statements to the contrary. However, there is strong evidence throughout the history of physical sciences that such claims of the self-sufficiency of consciousness and thought cannot be defended.

We represent what we perceive and make theories of them, and usually it is these theories that are presented as the truths of the physical nature. Even if new physical facts are in front of us, as something that can be logically examined, the individual and the community can continue to refuse the new truth, and go on believing in an existing, possibly false, theoretical picture of the physical world. Of course, what I am saying here is obvious, and there are many examples in the history of sciences, especially the physical science. To see the importance of the situation discussed here, imagine that the human consciousness had an innate universal ability, among other divine virtues, to recognize true statements about the physical nature, when they stated in an explicit form. All one has to do to make fast progress in science of nature is to generate all possible linguistic statements, using an algorithm, and the conscious mind will pick the truths and reject the false statements. But, this does not work and one has to resort to seeking experience from a multitude of experiments to arrive at even partial truths. What is really appalling is that even after it is argued, using experiments, that the truth is different from what one believes till then, the conscious mind, either at the individual or at the collective level, may not recognize it and it can take a long time before a natural truth gets recognized and accepted.

At this point I should clarify that I do not undermine revelations occurring to individuals about truths of nature, based on their experiences, imagination and thinking, some of it operative only in the inner layers of the mind. Many of these revelations may turn out to be verified later by empirical methods, but this by itself does not point to any ability of the conscious mind to reach statements of truths by pure thinking devoid of empirical experiences because revelations are related in a subtle way to experience. I should also clarify that I use the terms consciousness and conscious mind in a collective sense, without demarcating layers like the subconscious.

The case study I would like to present is one aspect in the physical problem of motion, namely the relation of the speed of light to the state of motion of an observer. There are several reasons to take this example. One is that almost everybody is familiar with various aspects of motion, from direct experience, and even those aspects that are not so familiar can be described in a simple way. At least the gross aspects of motion are first person experiences. Another reason is that my research in physics is deeply related to the problem of motion, inertia, and experience of the physical world in moving laboratories, and this familiarity allows me to make certain strong statements supported with logic and with experimental results. Third, we just completed celebrating a theory of motion all of us believe in and even worship in a way, the special theory of relativity, with great enthusiasm, and this theory and its foundations happen to be grossly incorrect when contrasted with results from real experiments! Finally, it seems very easy to explain why this theory, believed to be true for last hundred years, is not compatible with either experience or experiments, and why it is incompatible and inconsistent with our cosmology, the knowledge of our large scale environment. (Even quantitative statements of this argument can be presented using very simple and familiar algebra.) Therefore, the hope is that everybody can see the point even if there is no expertise or even familiarity.

To keep the discussion simple and short we take up just one belief that is held about the physical world – that the velocity of light is independent of the velocity of the observer or of the source of light. This assumption is the basis for Einstein's special theory of relativity. Even school children know, as a universal truth of physical nature, that the speed of light is asserted to be an absolute constant, independent of the velocity of the source or that of the observer who is measuring the speed. I want to examine the empirical basis for this assertion, and its compatibility with some facts and experiments that haven't been considered before. (I use the terms 'speed' and 'velocity' interchangeably, since we will be treating one dimensional problems.) The theory of relativity before Einstein's theory became popular, Lorentz's theory of relativity (generally called the Lorentz-Poincaré relativity), or even Galilean relativity (applied to waves), had about half of this assumption as its truth – that the velocity of light is independent of the velocity of the source, but the velocity of light was different for different observers moving relative to each other. Let us look at these two different postulates about the physical world in some detail.

The velocity of sound waves in a room, through the air, is independent of whether I am standing still or whether I am running while speaking. That is considered natural, since the velocity is determined by the properties of the medium and not by the velocity of the source of sound. (This is not the case for particles of the classical physics; their speed does depend on the speed of the source that emits them.) Similarly, waves on the water surface move at some velocity, relative to reference marks that are stationary relative to the water surface, determined by the properties of water and the reservoir. The velocity of water waves does not depend on the speed of the boat that created the waves. However, once the wave is generated, their observed speed depends on whether the observer is moving or not. The speed determines the time it takes to cover a fixed distance in the reference frame used for the measurement. It is easier to discuss this with the help of a diagram.

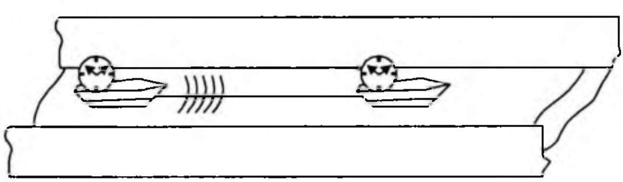

Figure 1: Observers equipped with clocks in two boats in a canal trying to measure the one-way speed of waves in water.

The *one-way velocity* can be said to be measured only if the waves do not retrace their path during the measurement. For example, this can be done if there are two observers with their clocks initially synchronized, and running at the same rate, placed at two different points. If the two boats (observers) are stationary with respect to the medium (water in the canal) then the waves generated near one boat will take some time T to reach the other boat, and if the separation between the reference points in the boats is L, the speed is $c=L/T$. On the other hand if the two boats are moving forward in unison (with a fixed tie of length L in between), by the time the waves reach the second boat that is ahead, that reference point would have moved forward with the boat; the waves will have to catch up an additional distance l to reach the observer. Obviously the time taken is longer, though the distance between the reference points (the two boats) is still L. Therefore, the effective speed of the waves will be lower, and a calculation shows that it is simply $c-v$ where v is the speed of the boats. Similarly, if we are trying to measure the speed of the waves emitted by the boat 2, received by the boat 1 moving towards the waves, the effective speed will be $c+v$. This is what is natural for waves in any medium and this is what our experience is.

But suppose that we do not have two boats and two clocks. Then the *two-way speed* of the waves can be measured by sending the wave, and getting it back after a reflection on a reference reflector at a fixed known distance L from the boat. If the boat is not moving, then the measured speed is taken as the true speed which is of course $c=2L/T$ where T is the time taken (which is different from the time taken in the one way experiment.)

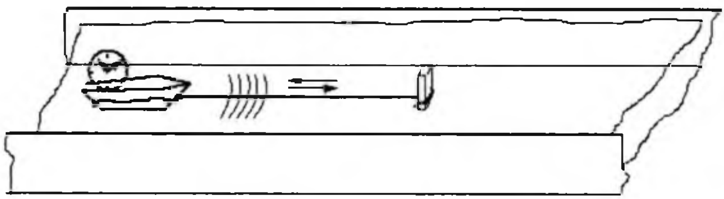

Figure 2: Observer in a boat measuring the two-way speed of waves with the help of a single clock and a reflector fixed at a known distance from the boat.

If the boat (and the reflector along with it) is moving through the canal, then the measured speed will not be the true speed in the medium. One might think that the extra time the waves take for reaching the reflector that is moving away, as the waves progress towards it, will get compensated when the waves reflect back and go towards the boat that is moving towards the waves. This compensation is not perfect. The time taken for the trip 'up' is $T(u) = L/(c-v)$ and the time taken for the trip 'down' is $T(d) = L/(c+v)$ since we know from the previous experiment with the two boats that the effective speeds are $(c-v)$ and $(c+v)$ respectively. So, the total time taken is

$$T = T(u) + T(d) = \frac{L}{c-v} + \frac{L}{c+v} = \frac{2L}{c}\frac{1}{(1-v^2/c^2)} \qquad (1)$$

This is slightly longer than the time $2L/c$ expected if there was perfect cancellation of the up and down time differences. Since the correction term contains only the square of the ratio of the speed of the reference frame and the speed of the waves, the excess duration is very small in most situations. For the earth moving around the sun, with speed of about 30 km/s, the correction v^2/c^2 for the two-way propagation of light is only a few parts in a billion (5 nanoseconds in 1 second, for example).

It is precisely this small expected difference, when the moving observer is attempting to measure the two-way speed of light, that was proposed to be measured in a precision experiment by Michelson and Morley to test whether the observers on the earth is moving through the aether, which was supposed to be the medium that supported the propagation of light. It is not important to describe how exactly this was tested, but the results of the test turned out to be very surprising since the small correction was not seen[1], even though the experiment had the sensitivity to see changes that were much smaller! It was as if the two-way time was just $2L/c$, exactly as would happen if the effective speed of the waves both ways were exactly c. Another equivalent statement would be to say that the results are identical to the situation when the boat and the reflector (observer) are not moving at all. Thus the results of the experiment had no signature of motion through the medium, excluding a method of determining the speed of the observer through the medium. But neither of these statements was made when the results of the Michelson-Morley (M-M hereafter) experiment became known since that would have gone against experience derived from experiments with other waves familiar to physics. Instead Lorentz, and earlier Fitzgerald, proposed that all lengths will suffer a physical contraction along their direction of motion by an amount given by $(1 - v^2/c^2)$. This was a radical proposal, but it solved the problem since if the distance that is used to measure the speed of the waves contract by this amount, then there is this factor in the numerator of equation (1), canceling the same factor in the denominator. Thus Lorentz contraction explains well the null result of the M-M experiment and this explanation stood for about 10 years as the reason for the null result of the experiment.

It is very important to note that the Lorentz-Fitzgerald proposal acknowledges that the speed of light is dependent on the velocity of the observer. This need to be stressed because many people do not realize the difference between this explanation of the null result by a real and absolute Lorentz contraction, and the explanation based on

Einstein's special relativity in which there is no real length contraction for the observer who is moving along with the experimental apparatus and the earth. In special relativity it is proposed, as a fundamental hypothesis, that the speed of light is a universal constant, *c*, independent of the velocity of the observer. This then means that the time it takes to cover a distance *L* is *L/c* irrespective of whether the reference length used for the measurement is moving in space or not. Obviously, then the time it takes to make a two-way trip after reflecting is twice the time taken for the one-way trip, in contrast to the two different durations, one longer and the other shorter than the duration *L/c*, it takes in the standard wave theory. Therefore, in special relativity, the null result of the M-M experiment is natural for the observer moving along with the interferometer, without any length contraction. In fact, a real physical length contraction of the apparatus will spoil the agreement with the experimental result.

The up and down times for the propagation of the waves are identical in special relativity even when the laboratory is moving in space. Of course, it is not natural for the conscious mind that has other experiences to the contrary, yet it is faced with the necessity of accepting this strange hypothesis because that can explain the failure to detect that small difference in time durations in the M-M experiment. But once this is accepted, one also has to reject that the propagation of light is supported by a medium because we reach a conflict with the ideas of the properties of the medium determining the speed of the waves. Thus, in special relativity, a reference frame and an observer in it moving uniformly in a straight line are completely equivalent to a reference frame and an observer at rest. As Max Planck put it[2], "the gist of the principle of relativity is the following. It is in no wise possible to detect the motion of a body relative to empty space; in fact, there is absolutely no physical sense in speaking about such motion. If, therefore, two observers move with uniform but different velocities, then each of the two with the same right may assert that with respect to empty space he is at rest, and there are no physical methods of measurement enabling us to decide in favour of one or the other".

At this stage, I would like to stress the point that both the Lorentz-Fitzgerald hypothesis of length contraction and Einstein's hypothesis of the constancy of the speed of light relative to all reference frames are consistent with the null result of the M-M experiment, as well as with the results of all other electromagnetic experiments. As Einstein wrote in a letter[3] to F. Adler, Sept. 1918: "A decision between Lorentz and Einstein is impossible, anyway, since *factually* Lorentz's theory agrees entirely with the special theory of relativity." (Here, 'factually' means 'in terms of the empirical tests conducted at that time. The theories are actually completely different). Therefore, Lorentz's theory was discarded, slowly, only because people did not like the concept of the invisible aether and the idea of real length contraction, as a physical deformation. Special theory of relativity looked simpler, and it was based on principles that were clearly stated. Yet, one should keep in mind that empirical evidence in its favour is not superior to the evidence for the validity of Lorentz's theory.

Before we go on to discuss the empirical evidence regarding the proposal that the speed of light is a universal constant independent of the velocity of the observer, we examine briefly some theoretical consequences of the hypothesis. Even though there is no real length contraction in special relativity, in the sense imagined by Lorentz, an apparent, observer-dependent length contraction becomes necessary for consistency. Consider an observer who is stationary relative to the water in the canal, observing the experiment of the measurement of the speed of waves by the observer in the boat (figure 2). For him, the boat is moving and the waves have to catch up with the reflector one way, and the boat will catch up with the reflected waves the other way. Since he is stationary relative to the medium (water) the speed of the waves is c both ways, but the effective distances have changed. Therefore, the duration taken by the waves one way is longer than L/c and it is shorter than L/c for the reflected waves. This will imply that the total duration, as far as the observer on the banks is concerned, is slightly more than the expected $2L/c$ as given by the equation (1). This applies to the propagation of light as well. But the result of the M-M experiment is an invariant – the same (zero) for all observers, and this can be accommodated in special relativity only if there is an apparent length contraction for the observer on the banks, relative to whom the boats are moving. This is the 'Lorentz contraction' in special relativity, and it is observer-dependent and has no objective and absolute meaning.

There is a conceptual problem associated with the non-absolute nature of the Lorentz contraction in special relativity that has not been adequately addressed. While it is consistent to say that the length contraction is a co-ordinate effect that is dependent on the observer, and that there is no real physical contraction of the moving object, such a detached view becomes inconsistent and ambiguous when one comes to the issue of time dilation. In theories of relativity, moving clocks run slower than stationary ones. Time is an accumulated quantity, and it is the rate of progress of time that is affected by motion. In Lorentz's theory, the time dilation is absolute – clocks that travel relative to the aether run slower than the clocks that are stationary relative to the aether. But in special relativity, there is no absolute and objective time dilation. The effect is purely relative, and for any observer in inertial motion (motion without accelerations) it is always the 'other' clock that runs slower. But, when there is a possibility to compare two clocks, it becomes relevant to ask which of the clocks 'really' advanced slower. The theory has to answer this question, and special relativity does not, as Einstein himself clarified in a paper in 1918. Instead of dwelling more on this issue, since I have discussed this in detail elsewhere[4], we now go further to explore the issue of the one-way speed of light.

It turns out that there is not even a single experiment that provides direct evidence for the hypothesis that the one-way speed of light is independent of the speed of the observer. However, there are several experiments that support the hypothesis that the two-way speed of light is independent of the speed of the observer. Therefore, the foundational hypothesis of special relativity has no direct empirical support. The hypothesis is a leap from the results on two-way speed to a conclusion regarding the one-way speed.

Why is it possible to sustain the hypothesis of the constancy of light without any conflict with experiments? The reason, in the context of a conventional one-way speed measurement, has to do with the synchronization of clocks. Two clocks that are at a distance need to be synchronized before they can be used for a measurement of the speed; either they have to be synchronized at the same spatial region and then transported, or some synchronization signal needs to be transmitted across the clocks such that the relative rates and the readings of the two clocks are precisely known. In the first case there are corrections to the clock readings and rates due to the motion, and in the second case, the signal that is sent for synchronization is essentially the same as the signal whose speed one is trying to measure. Therefore, in both methods, the consequences of the theory play a role in the set up designed to test the theory, and there is significant amount of circularity. A careful analysis of the details show that synchronization of spatially separated clocks using light allows us to consistently maintain that the one-way speed of light measured using such clocks is independent of the speed of the reference frame in which the measurement is executed. Due to the circularity, however, this is not an empirical support for the hypothesis, as we will see soon.

Given the two statements – one stating that the one-way speed of light is independent of the velocity of the observer, and the other stating that it is dependent on the velocity of the observer, how does one decide which of the statements is correct? As I was claiming earlier, the conscious mind has no innate way of determining the relative truth of these statements. It has to depend on experience and empirical evidence. In 1905, there were two paths available to make progress in the general theory of motion, both with apparently equal success in explaining empirical results known at that time. For various reasons including historical and sociological ones, and certainly not by demarcation based on rigorous empirical evidence, Einstein's special relativity was chosen and built on later, instead of the Lorentz-Poincaré theory of relativity. One of the reasons for the bias towards special relativity was the general setting in which it was proposed, applicable to all of inertial kinematics, whereas the Lorentz-Poincaré relativity had the initial flavour of being specialized to electrodynamics.

Before we consider the possibility of measuring the one-way speed of light without having to synchronize clocks that are spatially separated, there is an important aspect to be discussed briefly regarding the general empirical support for the special theory of relativity. When the theory was proposed, it was supposed to applicable only to observers and measurements in inertial frames – reference frames that move linearly, without accelerations. However, such a theory is untestable because the earth and every measuring equipment used in experiments are noninertial. Since results from many noninertial experiments designed to test the theory of relativity match with the predictions based on the theory, it is clear that for some reason the restriction proposed by the special theory of relativity that the theory be applicable only to inertial frames is not valid. In any case, if such a restriction is insisted on then there is no empirical evidence whatsoever in support of the theory. I stress this point here because very few people who use the formulae of the theory (Lorentz transformations) seem to understand the theory of relativity itself, and one can often see statements by professional physicists that the theory is not to be invoked when there are accelerations. However, the same physicists use the theory, as prescribed in textbooks, for analyzing the kinematics of particles in particle accelerators of different kinds and particles decaying in cosmic rays and so on, all done in the non-inertial accelerating frame of the earth! Thus, both the particles and the frame of the observer are accelerating in every such instance. I have analyzed this example in the context of a study on the beliefs and superstitions prevalent in the physical sciences, and it has always been a surprising fact to me that many physicists do not insist on rigorous logical consistency, let alone plausible ontology and strict adherence to empirical support, while building theoretical representations of the physical world.

It turns out that there is one way of measuring the one-way speed of light or other signals without using two spatially separated clocks. The main requirement is not to allow the signal to retrace its path, and yet bring the signal back to the starting point so that the same clock can be used to measure the duration between the emission and reception of the signal. This is possible in a very simple experimental configuration as I realized a few years ago[5]. Before we discuss this, it might be useful to discuss another example, to fix the ideas.

If one wants to conduct a race over some distance *L*, say 100 meters, then usually the race track is linear, and what is compared is the time of arrival of the racers at the final tape, assuming that they all started at the same time. For each person in the race, considered as the observer, the relative speed of others is the distance covered by others per second, relative to him, as per his clock. If the race is over a larger distance, 400 meters, then usually the race track need to be closing on itself, with curves, to accommodate the track within reasonable area. But the basic principles of comparing the winners, or estimating the relative speeds do not change. These are done as if the track is one dimensional, and any one person estimates the relative speeds of all others with respect to him by estimating the distance covered by them *along the track* per second, relative to him. For example, when somebody much ahead of him, and running faster, seems to run opposite to him on the other side of the oval, he cannot consider that the relative velocity has become negative and that they are running towards each other! They are not, and distances are actually increasing. In such a track, if there are two people racing in opposite directions (see figure 3) such that their speeds relative to a third person, designated as the 'moving observer', are identical, then according to the moving observer, the forward and backward distances along the track to the other two are identical in magnitude at all times.

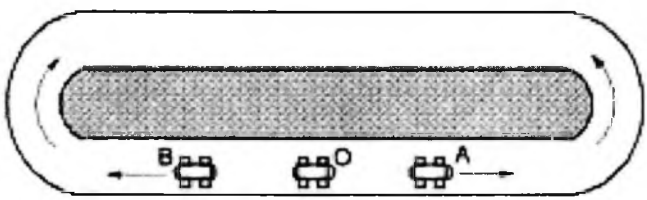

Figure 3: Round trip race on an oval race-track. 'O' denotes the moving observer relative to whom the speeds of 'A' and 'B' are measured. Equal relative speeds imply equal relative distances.

This means that the two will meet the moving observer at the same time after a round trip. On the other hand, if the race is arranged such that the two are running in opposite directions at equal speeds relative a stationary observer, standing by the track, then the two will meet the moving observer at different times after the round trip. Relative to the stationary observer, the 'observer' on the track (O) is also moving. So, in this example, there is no way one can have the relative speeds identical for the two runners relative to both the moving observer and the stationary observer. If the speeds in the two directions are identical relative to the moving observer, then necessarily the two runners will meet the moving observer at the same time, simultaneously, after the round trip.

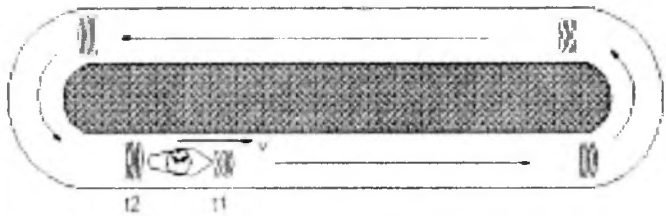

Figure 4: Measurement of one-way speed of waves relative to the moving boat.

Now consider the experiment with waves suggested in figure 4. The 'canal' in the earlier discussion for measuring the speed of water waves is designed to be closing on itself, like a race-track. To satisfy various belief systems, we will keep the entire motion of the observer (the boat with a clock) to be linear and acceleration free. Since a good clock is synchronous with itself, by definition, the time interval between the emission and reception of the wave pulse can be determined with a single clock as the waves go around and reach back the observer. If the average perimeter of the canal is *L*, the speed of the waves is *L/(t2-t1)*. The only quantity that is measured in the experiment is the time interval (*t2-t1*). But if this experiment is done, the measured speed of the waves will be seen to depend on whether the boat is moving or not. That is, the time interval (*t2-t1*) depends on the speed of the observer, and by simply measuring this time interval the observer can determine whether he is moving or not, and at what speed, linearly and inertially. This experiment can also be done using two pulses of waves, one emitted in the forward direction and another in the opposite direction. Then one tests whether the pulses come back at the same time or at different times. Everybody will agree, based on their experience with waves in water etc., that the pulse that is emitted forward will take more time to get back after the round trip if the boat and the observer are moving. Therefore, the two pulses will reach the moving observer at different times, indicating that the relative speeds in the two directions are indeed different.

What is the expected result if the experiment is done with light? Some mirrors can be used to make the light go around, or a hollow optical fiber can be used (we do not want the medium in which the propagation takes place move, because that can bring in additional corrections). If the two pulses arrive at different times to a detector moving linearly and uniformly, then we have to conclude that the behaviour of light is not different from that of the water waves. If on the other hand the pulses reach the detector at equal times irrespective of the linear speed of the detector, then we conclude that the one-way speed of light is a universal invariant relative to an observer in inertial motion. To fix the ideas further and to avoid ambiguities let us examine part of the experimental set up for light in detail.

The experiment consists of an emitter for light fixed to the reference frame of the observer, and an optical guide of length *L*. According to special relativity, since the effective speed of light is independent of whether the observer is moving or not, the observer would estimate that a pulse of light will reach the end of the guide after a time *L/c* irrespective of the velocity at which he is moving, exactly as in the case where he is at rest. Another way of getting the same result is to note Planck's statement on the 'gist of special relativity' that I quoted earlier – that an observer in inertial motion can claim that he is at rest. Then light pulses propagate exactly as if the observer was not moving, and obviously the time taken to reach the end is always *L/c*.

Figure 5: A portion of the experimental setup for measuring the speed of light guided through a hollow fiber of length L.

This conclusion remains the same in the configuration shown below, since the length of the guide to be traveled by the pulse of light remains the same, and the observer is still moving linearly and inertially. As the observer is moving forward, the end of the guide is pulled around a wheel so that there is no overall motion of the curved parts of the guide in space, and this avoids any possibility of 'carrying' the pulse by the guide in space. The length of the guide the pulse has to traverse is still L, and since the speed relative to the observer is supposed to be c, the expected time in the special theory of relativity is L/c. In both cases the distance between the observer and the end of the guide, as measured by the observer, remains a constant, independent of the speed of the observer.

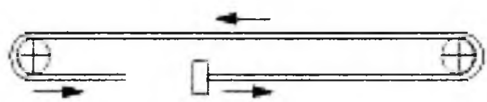

Figure 6: An extended configuration for the measurement of the one-way speed of light. The distance between the tip of the light guide and the moving observer (emitter-detector) remains a constant during the experiment, as in the previous figure.

Since the observer is moving linearly, without accelerations, there is full agreement regarding the applicability of special relativity, and since the speed of light is the same constant irrespective of the speed of the observer, the pulse should take the same duration to complete the round trip over the fixed length between the point of emission and the point of reception, as measured in the frame of the observer. Now the experiment proposed with the water waves can be implemented with light pulses as shown in the following figure. If the relative speeds of light in the two directions are identical, then the two pulses should reach the observer simultaneously after a round trip. This is an unambiguous prediction from the special relativity because in this theory the observer in linear inertial motion is equivalent in all respects to an observer at rest.

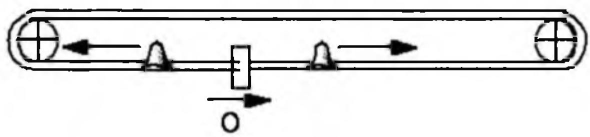

Figure 7: Comparison of the one-way speed of light in two directions relative to a moving observer 'O' (emitter-detector combination). The light pulses moving in opposite directions are shown in exaggerated size for clarity.

To make sure that this important point is clarified well, let me say it in another way. The speed determines the distance covered in a fixed duration of time. If the speed of the light pulses is the same in two directions, then at every instant, as per the clock of the observer, the distances to the pulses from the observer are identical. Since the distances from the reference mark of the observer to the same reference mark along the two possible paths, the forward and backward directed paths in the race-track, are identical at every instant, the pulses have to reach back along these paths at the same instant, simultaneously. (This is as in the case with the racers on the track we discussed earlier). This conclusion is inescapable in special relativity.

But the result of the experiment is a direct blow to the fundamental hypothesis of special relativity. Since one is dealing with waves, one can test whether the crests or troughs of the two waves arrive together or out of step, directly indicating the degree of simultaneity; this is the interferometry technique. Thus the race-track interferometer (which is a variant of the 'Sagnac interferometer'[6]) compares the *one-way speed of light* in two different directions relative to a moving observer, whereas the Michelson interferometer used in the M-M experiment compared the *two-way speed of light* in two different directions relative to the moving observer.

I have conducted this experiment in an interferometric configuration. Indeed, numerous such experiments have been done in the Sagnac interferometer configuration, from 1913 to the present times, without realizing that it is in fact a comparison of the one-way relative speeds of light in directions parallel and anti-parallel to the direction of motion of the observer. The results are exactly the same as one would obtain for waves in water or waves of sound in air. The two pulses reach with time difference proportional to the velocity of the observer. Therefore, the effective speed that is measured by the moving observer depends on the speed of the observer, as in the case of water waves, clearly indicating that the observer in motion is not equivalent to an observer at rest, in total variance with the quote by Planck we mentioned earlier. In fact, the results of the experiment are in complete agreement with the prediction from Lorentz-Poincaré relativity, as if there is a preferred absolute frame. In other words, the result of the experiment can be reconciled by the observer who measures the time intervals with his clocks only by accepting that he is 'actually' moving through a preferred absolute frame, and he cannot claim a state of rest even though he is in linear inertial motion. Empirically there is no difference between our experience with water waves (and sound waves), and our experience with light. Their measured one-way speed does depend on the velocity of the observer.

I am sure that despite this demonstration people will remain unconvinced, as I have seen during the talk in the conference, because their beliefs and prejudices are stronger than their ability to grasp empirical evidence. That is a severe limitation of the conscious mind. This was the point I was trying to make in the beginning. Not only that the conscious mind do not possess the innate ability to decide and pick the true statement from a set of plausible truths about nature, it often refuses to consider empirical evidence that can upset beliefs held about the physical nature. However, people who are reluctant to believe remain unable to justify or support their reluctance with any plausible rational argument, in spite of the physical, mathematical and the logical simplicity of the problem that we just discussed.

There is more evidence I can present to show that the predictions of special relativity have been invalidated by experiments, especially experiments of clock comparisons[7]. But, I do not think this is essential at this point since its foundational hypothesis of the constancy (observer independence) of the one-way speed of light itself is invalidated by experiments. However, it is necessary to explain why moving clocks run slower and why energy is equivalent to mass if the special theory of relativity is empirically invalidated. As I mentioned earlier, the Lorentz formulae for time dilation and length contraction are not a unique feature of special relativity – indeed they existed much before special relativity was proposed. So was the Lorentz relation connecting the electromagnetic energy and an equivalent mass. It turns out that the correct theory of relativity, consistent and in full agreement with all known empirical facts, is based on the gravitational interaction of every object with all other matter in the universe. This new theory of relativity, which I call Cosmic Relativity[8], has the matter filled universe as the preferred frame, and one gets the correct theory by replacing Lorentz's aether with the matter filled universe. Since there was no reliable cosmology and knowledge about the matter content of the universe in 1905, or even as late as 1970 or so, it is clear why it was not possible, logically or empirically, to arrive at a correct theory of motion and relativity till our knowledge about the universe matured. All relativistic effects, and in fact all physical effects that we include in kinematics of motion today, are all due to the gravitational interaction with the matter in the universe. It is the gravity of the universe that fixes the speed of light (similar to the way properties of water fix the speed of water waves), and it is the gravitational potentials of all matter in the universe that are responsible for the change of rates of moving clocks and the change of length of moving scales. All of these are 'absolute effects', depending directly on the speed through the average matter frame of the universe, and not 'relative effects' depending on relative velocity between observers as special relativity was claiming. The special theory of relativity necessarily has to be replaced by Cosmic Relativity that acknowledges the gravitational presence of the matter filled universe that we see. The inertia of beliefs will resist this paradigm change, but the change is inevitable in the light of overwhelming empirical evidence. I refer to other sources for a detailed discussions of these results[9].

The importance of the empirical anchor in our ways of knowing has to be recognized. The methods of science encompass first person experiences like revelations and human preferences on beauty and harmony, seemingly detached from the empirical examination of the external world as it is. However, subconscious revelations and flashes of realizations are subtly related to the collective empirical knowledge accumulated over ages. Every fundamental assertion on the nature of the physical world has to be tested empirically, as directly as possible, and that is the only way of ensuring the passage through the right path from among several plausible paths. Also, it is important to recognize that all of kinematics and dynamics, and indeed all motion including the actions of the conscious mind, are in the gravitational presence of the 'once given universe'[10]. Therefore, any fundamental theory of the physical world, be it relativity theory or quantum mechanics, should necessarily include this presence and its physical effects consistently into the theory and its interpretation. Physical reality cannot be approached if the obvious, overwhelming and the sensible reality of the matter filled universe is ignored. Cosmology should be a necessary basis of all natural sciences.

In summary, I have discussed and illustrated a deficiency of the consciousness, namely its lack of innate ability to recognize truths of nature from among a set of plausible statements about the behaviour of physical nature. I discussed the example of the measurement of the one-way speed of light to bring out the contrast between the belief held today without direct empirical evidence, of the universality of the speed of light, and the empirical truth of the dependence of the one-way relative speed of light on the velocity of the observer.

How long will you continue with your old belief?

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Notes and References

1 Detailed discussions on the Michelson-Morley experiment, performed in a conclusive way in 1887, can be found in most popular science books dealing with special relativity. See http://en.wikipedia.org/wiki/Michelson-Morley_experiment for an internet reference. Also, information on other relevant concepts like the Lorentz-Fitzgerald contraction can be found in the wikipedia site.

2 Planck, M., in 'Eight Lectures on Theoretical Physics', (Dover, 1998).

3 Document 628 in 'The collected papers of Albert Einstein, Vol. 8, The Berlin Years, Correspondence, 1914-1918' (English Translation, Princeton University Press, Princeton, New Jersey, 1998).

4 Unnikrishnan, C. S., 'On Einstein's resolution of the twin-clock paradox', Current Science **89**, 2009-2015 (2005).

5 These experiments were interferometer experiments in which light was sent in opposite directions from a common source in a closed loop using mirrors and then detected with a common detector, as the detector-source combination was moving linearly. A dependence of the position of the interferometer pattern on the velocity of the source/detector indicated that the one-way speed of light was not a constant relative to moving observers.

6 Sagnac interferometer (conceived by G. Sagnac in 1913) in the standard form is a circular race-track interferometer sensitive to rotations, and it is the basis of optical gyroscopes used as navigational aid. Stretching it out to a linear race-track is a significant conceptual leap in relation to the measurement of the one-way speed of light.

7 Reference 4.

8 Unnikrishnan, C. S., 'Cosmic Relativity: The fundamental theory of relativity, its implications and experimental tests', E-preprint, available at http://xxx.lanl.gov, gr-qc/0406043 (2004).

9 Unnikrishnan, C. S., 'Cosmic Relativity: The only consistent ontological foundation for the theory of space-time and relativity', to appear in 'Foundations of Science', Editor, B. V. Sreekantan (PHISPC, New Delhi, 2006); also see reference 8.

10 Mach, E., 'The Science of Mechanics', pp 277-306 (The Open Court Publishing Co. London, 1942); Unnikrishnan. C. S., 'Contemplations on our physical links to the universe: Searching for and finding the hidden harmony', LEONARDO **39**, 71-75 (2006).

Consciousness and Cognitive Anomalies

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What is Consciousness?

The term "consciousness" has multiple meanings. In a sense it is many concepts rolled into one. English language dictionaries list over twelve different connotations. There are equally numerous meanings of consciousness in psychological literature. Though psychology began as "the description and explanation of states of consciousness *as such*" (Ladd, 1909), psychologists at no time were able to give an agreed on and unambiguous definition of consciousness. Edward Titchner (1915) referred to its thirteen different meanings distinguished by Alexander Bain, and James Ward's description of consciousness as "the most treacherous of psychological terms". More recently, a dictionary of psychology has this to say about consciousness: "The term is impossible to define except in terms that are unintelligible without a grasp of what consciousness means" (Sutherland, 1989, p. 90). The difficulty of defining consciousness in psychological discourse has other reasons as well. There is a general lack of agreement on what the criteria of consciousness are. The phenomena of consciousness have an intrinsically subjective character. They are accessible only to introspection and are not directly observable from outside. The first-person-only direct access in one sense makes consciousness the most intimately known aspect of our being. For this reason some writers (Stout, 1899; James, 1890/1952) considered consciousness to be too familiar to require any definition. In another sense, it is possibly the least amenable of all psychological phenomena for scientific study. Therefore, some psychologists are convinced of the utter futility of the concept, because it is too subjective to be observed and studied from a scientific standpoint, which is the perspective of the third-person.

Consciousness as Awareness

Though its multiple connotations suggest that consciousness may not refer to one but several things, it is possible that all of them may be seen as constituting a cluster and related in a conceptually coherent way. In whichever way we look at consciousness and whatever meaning we may attribute to it, consciousness appears to refer always to some form of awareness. In all the senses in which consciousness is understood, awareness is implied. Consequently it is reasonable to assume that awareness may be an important and useful key for opening the doors to a meaningful understanding of consciousness.

Thomas Natsoulas (1978, 1983a, 1983b), who has noted in the *Oxford English Dictionary* seven distinct definitions of consciousness, suggests that consciousness in all these meanings implies awareness phenomena. First, consciousness as *mutual knowledge* is reflected in Skinnerian behaviorism, which regards consciousness as a social product, as well as in the psychoanalytical notion of consciousness as *expression.* Second, consciousness as *conviction* may be seen in G.H. Mead's theory of social origins of individual consciousness. The third usage of consciousness as *awareness* is the most obvious one. The fourth usage is *direct awareness* as implied in statements that speak of something being accessible to consciousness. In the fifth sense, consciousness means *internal unity* and continuity of awareness. The sixth and perhaps the most general usage is that consciousness is a *general state* of being aware. The seventh usage may be seen in descriptions of *double consciousness* or split awareness when one discusses dissociated states and multiple personality. "If the awareness phenomena", writes Natsoulas (1983a, 1983b), "is as ubiquitous psychologically as our ordinary concepts of consciousness consistently imply, then modern objective psychology inherits a major responsibility, namely the development of a scientific understanding of the common element that makes awareness a distinct kind of occurrence" (p. 122).

Basically awareness appears to be of two sorts. On the one hand, it denotes a state of being aware and, on the other hand, it refers to certain phenomena of experience. We say we are conscious while we are awake and alert, and unconscious when in coma. Also, we distinguish between states of awareness that are qualitatively different. For example, awareness in dreams is different from ordinary waking consciousness. Therefore, we speak of altered states of consciousness. Sometimes we distinguish between degrees of consciousness. We say we are "half conscious," meaning that we are not fully alert. Degrees of awareness, grades or levels of consciousness refer to differences in sensitivity, intensity of reflection, levels of creativity, originality, and so on. In all the ways just mentioned, consciousness denotes a state of awareness. It does not refer to awareness of something, but to itself. Awareness in this sense is a subjective condition. Consciousness in our phenomenal experience obviously refers to something more than alertness and wakefulness. It is an experience of being aware, and aware of something. It is an information state that gives us knowledge of an object outside or image inside. When we think, doubt, remember, or perceive, there is usually something to which our thoughts, memories, etc. refer. When we remember or perceive something, we believe that the world is represented to us in our consciousness.

Consciousness thus has its subjective and objective aspects. In its objective aspect, consciousness is about something and refers to information, one's knowledge or perception of events. In its subjective aspect, it is an experience of sensing something. Therefore, we may legitimately ask of consciousness what it is about (its information aspect) and what it is like (its subjective aspect).

The Four Ps of Consciousness

Viewing consciousness in all its forms is more like looking at a mountain or a pyramid rather than at a nonhierarchical flat terrain. Consequently, consciousness may appear to have different characteristics as we view it from different angles, examine it at different levels, and explore it with different perspectives. What may indeed seem to be appropriate criteria/description from one angle or perspective may turn out to be inappropriate when looked at from another. The conceptual maps and the methodological tools that are needed to explore the terrain of consciousness may have to be different as we move from one level to another.

Awareness in the abstract is a state of knowing. It relates the knower to that which is known. On the basis of the nature of the relationship between the knowing agent and the object of knowledge, awareness may be seen as falling into four broad categories: they are (1) primary awareness, (2) paradoxical awareness, (3) pathological awareness, and (4) paranormal awareness. I call them the four Ps, the four perspectives, of consciousness. These are not mutually exclusive categories. Rather, they are plainly identifiable aspects with their own distinctive characteristics. The apparent differences in their manifest characteristics at different levels often mistakenly lead to conflicting accounts of what consciousness precisely is.

Primary awareness is what we have in the acts of perception, thinking, feeling, and volition. Included in this category are perceptions, images, inner speech, feelings such as pain and the like, which have sensory qualities, as well as abstract concepts, beliefs, intentions, and expectations. The basic characteristics of primary awareness are its subjective quality, accessibility to introspection, and immediate transparency. Primary awareness is what William James called the "first concrete fact" and discussed extensively in *The Principles of Psychology.* In fact, many writers since Descartes and Locke referred consciousness exclusively to this kind of immediately transparent awareness.

Primary awareness is consciousness at the ground level. It is comprised of the multitude of percepts provided by various sensory modalities such as vision, touch, and smell, feelings like pain, joy, and anger, internal imagery, thoughts, and beliefs. Consciousness here refers not only to the awareness of the contents contained in them but also to the subjective quality inherent in them, the first-person aspect. In this form consciousness has the characteristics of being changing and yet continuous, like a flowing stream. It is noetic and has the cognitive function of knowing in the sense that it is about something. In being selective it attends to some inputs while ignoring others (James, 1890/1952; Searle, 1992). The phenomena of primary awareness are generally available for introspection in human subjects.

Consciousness at the primary level thus appears to have two components or aspects, the subjective and the objective. These two are also described as the phenomenal and functional aspects of consciousness (Chalmers, 1996) or as phenomenal consciousness and access consciousness (Block, 1995). From a methodological perspective, primary awareness is both a first-person and a third-person phenomenon. The uniqueness of conscious experience is that it purports to reveal objective reality, but at the same time it is observer-relative.

Several cortical processes are associated with the subjective conscious experience. Two stages of processing may be distinguished at this level. They are the pre-attentive processing of the inputs and focal attention. A central processor appears to rapidly integrate the events occurring during a short span of time. The impressions of immediate experience so generated are held in short-term memory and further integrations give one the unity and continuity of experience (Bluementhal, 1977). Volition seems to play a significant role in the process of attention, influencing conscious experience in important ways.

Paradoxical awareness is awareness that is not recognized as such by the person having it. Unlike primary awareness, it is neither accessible to introspection nor does it have a subjective feel. It is paradoxical in that it is a kind of "knowing" without knowing. If primary awareness is the most familiar form of awareness, paradoxical awareness is the least felt and, possibly, the more primitive of the two. Paradoxical awareness is implied in a variety of mental phenomena such as subliminal perception, implicit memory, and blindsight.

Subliminal perception refers to the possibility that people may be influenced by objects and events of which they have no subjective awareness. Research in this area has produced some interesting results. There is impressive evidence that stimuli present at low energy levels, or in masked forms so that they cannot be recalled, recognized, or discriminated from other similarly presented stimuli, can nevertheless produce detectable cognitive, affective, and other behavioral effects (Bornstein & Pittman, 1992). Even though several of the claims made and popularized in the media such as subliminal audio tapes continue to be controversial, there is compelling evidence to suggest that people do indeed respond to stimuli that they are not subjectively aware of.

Considering the extensive evidence gathered by numerous researchers utilizing a variety of experimental strategies, the existence of subliminal perception may no longer be in doubt. In fact, not only do we know that subliminal perception is real, but we also know a great deal about it. For example, we know that subliminal perceptions have emotional as well as cognitive effects. Subjects in subliminal studies successfully respond in lexical decision-making tasks (Marcel, 1983) as well as in tasks that elicit affective reactions (McGinnies, 1949). Subliminal stimuli can bring about attitude and mood changes (Kunst-Wilson & Zajonc, 1980; Weinberger, Kelner & McClelland, 1990). Subliminal stimulus effects may manifest not only in terms of subjects' responses and changes in attitudes and moods, they may also be revealed in free associations and dream images of the subjects, even when the subjects themselves are unable to recognize them as such (Haber & Erdelyi, 1967; Poetzl, 1917).

Analogous to subliminal perception is the phenomenon of *implicit memory*. Unlike in subliminal perception, the subject in an implicit memory task has subjective awareness of the stimulus when it occurs. The subject is unable, however, to deliberately recognize or recollect it later. Yet, the effect of the stimulus is seen in the subsequent performance of the subject in a manner similar to the performance of the subject in a subliminal perception study. For example, subjects tend to show appreciable saving in relearning items that they could neither recall nor recognize as seen before (Nelson, 1978). Such residual subliminal memory is known as implicit memory or indirect memory.

A number of studies (Weiskrantz, 1988; Schacter, 1985) have shown subliminal memory among amnesic patients. It is known that damage to certain midline structures in the brain can lead to serious amnesia in humans with the result that they are unable to remember their experiences beyond a few seconds. For example, a person suffering from such amnesia, who just solved a jigsaw puzzle, is typically unable to remember how she did it; but if asked to solve the same puzzle the next day, she would solve it faster than before. It appears that there is indeed enough residual memory to facilitate faster relearning of the same task.

As in the case of amnesic syndrome, brain-damaged patients show a variety of deficiencies of awareness, depending on the location and severity of the damage. The deficiencies include inability to see objects falling in the damaged visual field, failure to recognize familiar faces, and disruption in reading ability. There is evidence to show, however, that, when such a perceptual loss occurs at the explicit level impeding subjective awareness, some patients continue to retain the ability to have implicit or subliminal awareness similar to what we have noted with amnesics.

It has been observed that some people who are cortically blind because of damage to primary visual areas (striate cortex) can respond discriminatingly to different stimuli, even though they report no subjective awareness of them. Lawrence Weiskrantz (1986) among others carried out extensive investigations of such people and called the phenomenon blindsight. D.B., one of his patients, had left hemianopia consequent to the removal of a tumor from the right visual cortex. D.B. was neither able to name nor describe any object that was presented to his left visual field. However, when he was asked to guess whether the stimulus that was presented to him in the left visual field was "x" or "o" D.B. guessed correctly in 27 of 30 trials, suggesting that his ability to discriminate between the two stimuli was indeed preserved to a significant degree, despite a lack of subjective awareness that he could do so.

Pathological awareness is aberrant and dysfunctional awareness. As mentioned before, awareness primarily serves the function of relating us to the world by faithfully representing it either in concrete or abstract forms in actual or imaginary situations. However, awareness may sometimes misrepresent the world and lead us to indulge in behavior inappropriate to the occasion. Hallucinatory experiences and other forms of cognitive abnormalities are examples of pathological awareness.

Blindsight may be a consequence of brain pathology; but it is not dysfunctional. Also, subliminal perception and implicit memory do not constitute abnormality of awareness, whereas delusional thoughts and hallucinatory visions are abnormal. The dream experience, though in a sense hallucinatory, is considered normal because we assume certain relationships between types of processing and wakefulness. We infer abnormalities of consciousness when a type of processing appears incompatible with the associated level of wakefulness. Such incompatibilities play a role in the psychiatric description and evaluation of patients. Pathologies of consciousness resulting from inappropriate processing may be seen as more than useful descriptors of psychiatric disorders. They may also be helpful in understanding and explaining certain mental disorders as resulting from disconnections, disassociations and conflations between different levels of processing awareness.

In cases of clouding of consciousness, for example amentia, a sub-acute delirious state in which the patient engages in haphazard associations and random performance of old habits and shows a lack of thought, it is reasonable to suppose a dysfunctional higher-order conscious system. Again, we find among schizophrenic patients hallucinations (usually in the form of hearing voices), delusions (often involving claims by patients that their thoughts are controlled from the outside), and thought disorders (seen in fluent but abnormal speech, which makes little sense). These symptoms are usually attributed to abnormal processes. They may also be seen as abnormal perceptions. It is often suggested that the schizophrenic suffers from a defective filter and that the patient is overwhelmed by excessive stimulation and is no longer able to separate the relevant from irrelevant stimuli. It is equally plausible to argue that the schizophrenic symptoms constitute abnormal perceptions rather than indicate a defective filter.

Studies of paradoxical and pathological awareness strongly suggest that awareness can be explicit or implicit, the subjectively experienced and the covert. Further, awareness is unmistakably linked to brain systems. Different modalities of awareness are linked to different systems and localized in different parts of the brain. Damage to or dysfunction of a particular system may result in a concomitant change in awareness. Loss of subjective awareness of stimuli falling in the damaged visual field of the patients with blindsight, the covert awareness of faces by the prosopagnosic patients with bilateral lesions to the occipital-temporal regions of the cortex (Bauer, 1984), and the implicit perceptions of neglect patients with posterior parietal damage (Volpe, Le Doux & Gazzaniga, 1979) provide persuasive arguments in favor of cortical necessity and sufficiency to modulate and constrain awareness. We must, however, keep in mind the fact that similar changes and aberrations of awareness may also be observed without relevant cortical defects, for example in hysterical blindness and hypnotic amnesia and analgesia. It has been shown that some subjects in a deep hypnotic state fail to experience pain from a stimulus that normally causes pain (Hilgard & Hilgard, 1983). The "hidden observer" technique of making the subject give reports of pain experience which she denied earlier suggests that the analgesic subjects who report no experience of pain may have processed the pain stimulus thoroughly but the resultant experience is, however, dissociated from the stream of consciousness.

Whereas primary awareness refers to cognitive conscious states, paradoxical awareness belongs to the cognitive unconscious. Both primary and paradoxical awareness are cognitive in nature in that they contain information encoded and represented in certain ways and is accessible at conscious or unconscious levels. The latter constitute the cognitive unconscious, which in turn involves at least three different levels of processing described as unconscious, preconscious and subconscious (Kihlstrom, 2003). In the case of the truly unconscious states the information is in principle inaccessible to the person for example, automatic mental processes and unconscious procedural knowledge. In preconscious states, the representations of information received are not sufficiently activated to reach threshold levels to enable the person to have subjective awareness of them. The examples of preconscious processing are subliminal perception, implicit memory and blindsight. In subconscious states, though the representations are activated enough to reach threshold levels, they are not consciously experienced because they lack self-reference due to presumed dissociation between perceptual representations and the self.

Paranormal awareness is non-sensory and non-representational awareness. If ESP phenomena are real and the mystic states genuine, they are instances of paranormal awareness. At the outset, two kinds of paranormal awareness may be distinguished – (1) anomalous awareness and (2) awareness-as-such. Anomalous awareness is awareness implied in such paranormal phenomena as telepathy, clairvoyance, and precognition.

Paranormal awareness is considered anomalous in the Western scientific tradition because its occurrence is precluded on a priori grounds and seen as violating what C.D. Broad (1953) called the basic limiting principles ordained by the current dominant scientific paradigm. Awareness-as-such is conceived as nonrepresentational awareness, which has no content and is non-intentional. As the Hindu sage Ramana Maharshi, who was reputed to have experienced states of pure consciousness, says "when all thoughts are stilled, pure consciousness remains over." Robert Forman (1990) defines what he calls the pure conscious event (PCE) as "a wakeful though contentless (nonintentional) consciousness" (p. 8). Some forms of PCEs are believed to be rather common occurrences in the lives of ordinary people.

Unlike instances of awareness-as-such, ESP experiences have content. They convey information. They manifest in familiar forms similar in certain respects to primary awareness as well as paradoxical and pathological awareness. Veridical intuitions are very much like ordinary thoughts except that they convey information that is in principle inaccessible to normal cognitive activity. Often anomalous awareness is implicit; but it is unlike paradoxical awareness in that there is no physical contact or causal link between the stimulus and the subject in an ESP experience. Again anomalous awareness may occur in the form of a hallucination and may convey invalid information (psi-missing) and even be dysfunctional as in pathological awareness.

The defining characteristic of anomalous awareness is that it shows no causal connection with the presumed source, the object of awareness, and is therefore considered acausal by C. G. Jung (Jung & Pauli, 1955). Further, it is claimed that parapsychological phenomena are not influenced by space-time constraints. Also, sensory processes are believed to have no significant role in anomalous awareness. At the most, their role appears to be limited to making explicit the implicit ESP awareness.

In the light of the claimed experiences of the mystics and yogins, one may conjecture that it is possible to experience awareness-as-such. The defining characteristic of such an experience is that it has no representational content. It is simply a state that is essentially indescribable. The difficulty of conceptualizing such an ineffable state, if it exists, is quite obvious. However, the accounts we have of them from those who claim to have experienced awareness-as-such, inadequate though they are, provide some glimpses into it. In such a state the dichotomy between the subject and the object appears to disappear. The individual having such an experience is believed to realize the oneness and unity of all being. More importantly, experiencing awareness-as-such is seen to influence people profoundly and to bring about remarkable transformations in them.

There are good reasons for bringing anomalous awareness and awareness-as-such into a single category. They seem to be related at a fundamental level. The yogic tradition, which deals with supernormal abilities as well as pure conscious states, regards the former as preliminary manifestations that occur as one progresses on the path leading to the latter. It would seem that mystic states are states of consciousness-as-such, whereas ESP and such are its phenomenal manifestations. It is likely that paranormal awareness may involve two stages. In the first stage, there may be unmediated access to or identity with reality. It is a state of accessing pure consciousness. The second stage is a phenomenal expression of the pure conscious access, which may occur among those whose motivations are still anchored, in worldly activities and whose control over and suppression of cortical and sensory participation is not complete. Possibly for this reason yoga practitioners are warned against paying attention to supernormal phenomena, which are believed to impede the progress to reach the all important goal of achieving a stable and enduring state of pure consciousness.

From the preceding discussion of the four Ps of consciousness we can see how consciousness appears differently as we look at if from its different locations. At the level of primary awareness, the stream metaphor appears to be most appropriate as it captures the sense of subjectivity reflected in the unity and continuity of phenomenal awareness. The metaphor of stream, however, is of little help in the discussions of paradoxical awareness, which lacks subjective awareness. We find therefore philosophers like Daniel Dennett (1991), who are uncomfortable with the subjective aspects of consciousness and go as far as dismissing all the qualitative aspects of awareness (qualia) as imaginary and unreal, question the appropriateness of the stream metaphor. Even William James, as his interests moved away from primary awareness in *The Principles of Psychology*, to paranormal awareness in *The Varieties of Religious Experience* replaced the stream metaphor with the metaphor of the "mother sea" to describe consciousness. Again, psychologist Jung, who was more concerned with transpersonal aspects of consciousness, likened consciousness to the luminosity and brightness of light (Jung, 1919/1954).

So we see why we need different conceptual maps in order to understand different areas of consciousness. It is equally obvious that we require diverse methodological tools to explore the different regions of consciousness. Clearly, the subjective aspects of conscious experience require a first-person approach. Paradoxical awareness, however, may be fruitfully investigated with objective methods and from the third-person perspective. It is entirely possible that neurobiological studies may provide a complete description and explanation of implicit perception. When we move on to the area of paranormal awareness, however, we possibly need an altogether new approach, very different strategies to capture its essence.

I am persuaded to believe that exclusive concern with some Ps and the neglect of others or their conflation is at the root of much fallacious reasoning in consciousness studies. This is not the occasion to go into further details to substantiate this statement except to note that we must keep in mind the four Ps without conflating them for a meaningful understanding of consciousness, what it is about and what it is like.

Consciousness, it would seem, is much like a multi-tiered structure, a building with several floors. Primary awareness is like the ground floor, whereas the paradoxical awareness is the basement. Higher forms of consciousness look like the upper floors; and the terrace at the top, open and unenclosed, is analogous to pure consciousness or awareness-as-such. Pathological awareness may be seen as cracks in the wall or other defects we may find in the structure at any floor level.

Physical Explanations of Consciousness

Philosophical behaviorism, physical reductionism and cognitive functionalism have all in their own way helped to sharpen the discussion of consciousness. Neurobiological and cognitive psychological studies made notable contributions towards understanding many aspects of awareness. We know a great deal about the intimate association between cortical states and mental states. We know for instance that damage to the reticular activating system or suppression of its functions by drugs causes coma and that signals from the reticular activating system are necessary for sustaining consciousness It has been shown that in humans the integration of mental activity and attentional focus is achieved by the activity in the frontal lobes. Again, temporal and parietal lobes appear to play significant roles in higher-order cognitive functions such as thinking. These and other interesting discoveries in neuroscience, pointing to localization of numerous mental functions in the brain, and the developments in cognitive science, involving the computer modeling of the cognitive processes, made a strong prima facie case for assuming that the mind can be fully accounted for in physical and computational terms.

Now, let us consider the four Ps of consciousness and examine whether they are fully realizable by an entirely physical system. First, let us look at paradoxical awareness, which is the least complicated of the four. As mentioned earlier, paradoxical awareness refers to a variety of phenomena including subliminal perception, implicit memory, blindsight, and, covert awareness in prosopagnosia and neglect patients. There may be significant differences in the way different forms of paradoxical awareness, for example subliminal perception and blindsight, are processed. However, there is a commonality that binds them all. They are not experienced; they lack subjectivity. They are processed "in the dark," as it were. Awareness is inferred here from third-person observations and not experienced at the level of the first-person. Lacking in subjective quality, awareness here is seen in its functional manifestations. Consequently, in order to understand them we need only to specify the computational or neural mechanisms that perform those functions. This, as Chalmers would say, is the "easy" problem, one that could be solved in principle within the physical scheme of things, by the structural and functional studies of the brain and the nervous system.

As we move from the paradoxical to primary awareness, i.e., from awareness without subjective quality to felt awareness, we are faced with the "hard" problem of finding a proper explanation for subjectivity and the qualitative "feel" of cognitive components of perceptual experience. As pointed out earlier, primary awareness has subjective and objective components, the "what it is like" and the "what it is about" aspects. The physical explanations of primary awareness focus mainly on the latter. Either they ignore and eliminate the former aspect or attempt to show how it may be realized by a physical system.

Philosophical behaviorism sees in consciousness no more than certain behavioral states and dispositions. For example, pain in this view is a complex description of one's behavioral condition when one is in pain. States of mind are what those in those states do or would do. In other words, according to behaviorism, all statements about consciousness and the mental may be shown to be statements about behavior and dispositions to behave. The main problem with such a view is that some statements about conscious states may not be translatable into statements about behavior and dispositions. The experience of pain is hurtful and that feeling of "hurt" is not represented by the so-called dispositions to pain-behavior. A good actor may display pain behavior without experiencing pain. Again, one may experience pain without showing it. Also, we may note that the very notion of dispositions is open-ended and there is no limit to what one may or may not be disposed to do, when in anger, for instance. What we do, or are disposed to do, crucially depends on what we believe to be the case and on our desires and expectations. Consequently, any attempt to explain mental states in terms of dispositions introduces again mental states into the explanation.

Central-state materialism locates conscious states in the brain and nervous system and regards all conscious states as states of the brain. As D.M. Armstrong (1968) puts it, "mental states are not simply *determined* by corresponding states of the brain, but they are actually *identical* with these brain-states, brain-states that involve nothing but physical properties" (p. 182, original emphasis). In an incisive and critical analysis of contemporary materialism, John Searle (1992) has pointed out that materialism in all its incarnations, ranging from logical positivism and Watsonian behaviorism to identity theories and strong artificial intelligence, is essentially guilty of leaving out the mind; "it has left out some essential feature of the mind, such as consciousness or 'qualia' or semantic content" (p. 30). Searle has further argued that an identity theory, which identifies the properties of subjective experience such as pain, with the attendant neurophysiological properties in the brain either, "leaves out the mind or it does not; if it does, it is false; if it does not, it is not materialism" (1992, p. 37). The properties of pain are either mental or they are not. If an identity theory asserts that the experience of pain is mental, it is no longer a materialistic theory. However, if the theory leaves out the subjective feature of the pain experienced, it essentially leaves out the mind.

Functionalism holds that all mental states are functional states and that they can be defined in terms of sensory inputs and behavioral outputs (Shoemaker & Swinburne, 1984). In the functionalist view, mental states are not mere states of behavior disposition, as behaviorists hold. Nor are they identical with the brain states, as the identity theorists believe. Rather, a mental state is a functional state. As Hilary Putnam (1991) argues, "pain is not a brain state, in the sense of a physical-chemical state of the brain (or even the whole nervous system), but another kind of state entirely. I propose the hypothesis that pain, or the state of being in pain, is a functional state of the whole organism" (p. 199). The input-output model of functionalism is clearly a favorite of cognitive psychologists engaged in abstract modeling of cognitive processes independent of their neurophysiological basis, and the researchers in artificial intelligence, who are occupied with writing computer programs that perform the functions analogous to those performed by the human mind. The relationship between the brain and the mind is considered similar to the one between hardware and software in the functioning of a computer. Consciousness is the software program running on the hardware brain. From the functionalist viewpoint it is not inconceivable that non-organic entities like computers may have mental states. What is considered relevant here are the functions that a system performs and not the substance or the material that constitutes it. Some functionalist philosophers hold, however, that a structure like the brain with complex, multiple and parallel connections is necessary to produce mental states and that computational models of the mind are simply inadequate to this task (Bechtel & Abrahamsen, 1991).

There are several well-known objections to functionalist theories of consciousness. Like materialist theories, functionalism provides no viable explanation of the subjective and qualitative aspects of awareness. The qualia, the phenomenal properties of conscious experience, appear to be too elusive to be captured in a functionalist theoretical framework. They have so far defied all attempts to be successfully defined in terms of functional roles. "The subjective character of experience," writes Thomas Nagel (1974), "is not captured by any of the familiar, recently devised reductive analyses of the mental, for all of them are logically compatible with its absence. It is not analyzable in terms of any explanatory system of functional states, or intentional states, since these could be ascribed to robots or automata that behave like people though they experience nothing"(pp. 166-167).

Some philosophers of functionalist persuasion have gone so far as to deny that qualia exist. For example, Daniel Dennett (1997) categorically asserts, "there simply are no qualia at all" (p. 620). If the essential features of qualia are that they are "ineffable, intrinsic, private, and directly or immediately apprehensible in consciousness," Dennett argues that there are no properties in conscious experience that match such a description. He concludes, "qualia is a philosophers' term that fosters nothing but confusion, and refers in the end to no properties or features at all" (p. 623). Even the Churchlands (1982), whose physicalist bias can hardly be doubted, disagree with such a blanket rejection of qualia. "The functionalist need not, and perhaps should not," they counsel, "attempt to deny the existence of qualia. Rather, he should be a realist about 'qualia' and hope that their nature would eventually be revealed by "neurophysiology, neurochemistry, and neurophysics" (p. 31). Patricia Churchland likens consciousness to heat. When we keep something in the microwave to heat, the molecules of the food in the microwave start to move faster and faster. The motion of the molecules does not generate the heat; it is the heat. Likewise, consciousness is not produced by the functions of the brain. Rather the functions themselves are consciousness. We are back again in the court of identity theory and reductive materialism!

Even regarding the "aboutness" aspect of consciousness, there are those who argue that materialism is inconsistent with the notion of intentionality. Most philosophers in the Western tradition have assumed that intentionality is the defining characteristic of consciousness. By intentionality it is meant that consciousness is *of* or *about* something (Brentano, 1925/1973). Some philosophers consider that intentionality is an irreducible and intrinsic and non-dispositional property of the act of consciousness. If that is the case, there can be no convincing materialistic explanation of self-knowledge, knowledge of one's thinking and the contents of thought (Madell, 1988). We all have intentional frameworks of beliefs, which we use to evaluate and make normative decisions. Such intentional frameworks that enable us to deliberate, reflect and evaluate are in principle not analyzable into any descriptive frameworks, whether neurological or physical (Kim, 1985).

Moving away from general philosophical discussions to a consideration of the more specific attempts to relate subjective experience to brain states, we find three broad types of approaches in neuropsychology. One approach is to conceive of particular brain systems as mediating subjective awareness; another is to suggest that subjective experience is not an outcome of the activity of any particular brain systems, but involves integration among different neural systems. The third approach associates subjective awareness with the "higher-quality end of the continuum of degrees of representations" involved in information processing (Farah, 1997).

An example of the first approach is the DICE (dissociated interactions and conscious experience) model of Daniel Schacter (1989). Schacter postulates a cognitive module, labeled as conscious awareness system (CAS), which mediates subjective awareness. The CAS is separate from the brain systems associated with different cognitive activities, which are called knowledge modules. It is also different from the executive system, which makes decisions and initiates actions. The CAS is conceived as a monitoring system, which on the one had integrates and relates information from different knowledge modules and provides inputs to the executive system whose outputs it receives in turn. When the CAS is disconnected from other brain systems mediating perception and memory, those perceptions and memories remain implicit. Thus the difference between paradoxical awareness, such as subliminal perception and implicit memory and primary awareness is that in the former there is a disconnection between the CAS and memory and perceptual modules.

The second approach is represented by the integrated field theory of Marcel Kinsbourne (1988). In this approach subjective awareness is not the property of any particular neural system, but rather a state of integration among different systems in the brain. Various modality-specific perceptions, memories, action plans, and so on arising from disparate brain systems interact to bring about a mutually consistent and integrated state. This state is continually revised and upgraded to reflect all the information available in different parts of the brain. It is possible, however, because of damage to one or more brain systems as in prosopagnosia or neglect, normal integration of the output of the different systems involved may be weakened or disrupted, thus preventing the updating of the contents of awareness. Consequently, the person lacks subjective awareness of the information that fails to be incorporated into the integrated state. Subjective awareness in this view is thus the result of the integrating activities of several systems in the brain.

The third approach draws its support from the fact that information in neural networks is not represented in all or none fashion. It is possible for the information to be represented partially or in a degraded manner. If the quality of representation does not reach certain levels of clarity or intensity then that representation lacks subjective awareness. It is also suggested (Armstrong & Malcolm, 1984) that subjective awareness arises from the scanning of neural representations in the brain. When these representations are too weak to be scanned, we have no subjective awareness of them.

This is all very interesting and may indeed lead to some important research. However, one may legitimately wonder whether any of these hypotheses throw useful light on the main question of why we experience the way we do. We have no difficulty in agreeing that a person in coma is unconscious and that injury to the brain may alter one's conscious experience. No one denies that conscious experience in the human condition depends decisively on the cortical processes. The real question is, are they sufficient to account for all aspects of conscious experience?

From the preceding discussion we see that physical explanations of consciousness appear to leave out something, which may be quite basic to consciousness, viz, the subjective quality of experience. Thomas Nagel (1974) argued persuasively that no naturalistic explanation of consciousness can capture the "what it is like" quality of subjective experience. Colin McGinn (1991) echoed a similar view and suggested that we are "cognitively closed" to understand subjectivity. However, scientists in general do not seem to be bothered by this. Instead they have focused almost entirely with the cortical connections awareness has and are content with knowing the structural and functional aspects of awareness. Therefore, there is little disenchantment in scientific circles with the materialist theories. Even Nagel and McGinn continue to subscribe to naturalism of one sort or another. Moreover, science favors simplicity and unity; and materialist accounts of consciousness fit well with the general physical paradigm to which most scientists subscribe. Also the private nature of subjectivity and its inaccessibility to third-person observations makes many scientists disinterested in that aspect of consciousness. Further, to many scientists dualism is a "metaphysically repellant doctrine", as McGinn put it. The mysteriousness of posited causal connection between the material and the nonmaterial is an enigma that frustrates many. In the absence of more compelling rejection of the basic materialistic assumptions, it is unlikely that science would give up its materialistic bias even though it is becoming increasingly clear that we may never find a satisfactory physical explanation of subjectivity inherent in one's conscious experience.

As we climb up from the "main-floor" of primary awareness to the higher-levels of paranormal awareness, the inadequacy of all physical explanations of consciousness becomes more glaring. Credible scientific claims are made for the existence of parapsychological phenomena (Rao & Palmer, 1987). If we take these claims seriously, we are inexorably driven to raise fundamental questions about the role of consciousness in our being. For this reason John Beloff (1962), for example, considers parapsychology as "the ultimate battleground on which the mind-body controversy must be fought out. For, if no plausible physical explanation can be offered for what are ostensibly paranormal phenomena, the radical dualist approach would appear to win by default" (p. 229).

The Reality of Psi

What are parapsychological phenomena? Are they real? Can they be explained within a physical framework? Answers to these questions have important implications to our understanding of consciousness. The Parapsychological Association (1989) defines parapsychology as the discipline with studies "apparent anomalies of behavior and experience that exist apart from currently known explanatory mechanisms that account for organism-environment and organism-organism information and influence flow" (pp. 394-395). In order that they may not be confused with concepts that have occult and nonscientific connotations, parapsychologists chose the Greek letter "psi" to refer collectively to parapsychological phenomena. Psi is conceived to have two aspects—the cognitive or the receptive aspect and the kinetic or the expressive aspect. The cognitive aspect of psi is commonly designated as ESP or extrasensory perception. ESP is awareness of something outside oneself obtained without the use of known senses. It includes precognition (the ability to foretell future events), telepathy (thought-transference between two people), and clairvoyance (ESP of objective events). The expressive aspect of psi is called PK or psychokinesis, and is commonly described as the direct action of the mind over matter. Even though parapsychologists have developed specific methods to test for each of these types of psi, it is now increasingly recognized that all of them stem from the same source.

Surveys show that a significant majority of people, even in the Western societies, believes in ESP and related phenomena. Further, many people who responded attest to their occurrence in their own lives. For example, a *Newsweek* poll (November 3-4, 1994) revealed that about 60% of Americans felt the need to experience spiritual growth and that one third of them had mystical/religious experiences. In another survey, 51% of Charlottesville, VA, residents and 55% of University of Virginia students reported to have experienced some form of ESP (Palmer, 1979). Whereas many scientists outside of parapsychology remain skeptical of paranormal claims, the consensus among the scientists who are actually involved in psi research is that there is compelling evidence in support of ESP and PK.

The Evidence

The evidence of ESP is of two kinds. First, there is the body of reported cases of paranormal ESP experiences. Consider for example, the case noted by the renowned German philosopher Immanuel Kant. Emanuel Swedenborg, a versatile scholar, visiting a friend in Stockholm, had a sudden "vision" of a raging fire at that very moment in the city of Gothenburg about 300 miles away. Swedenborg described the fire and how it was extinguished "third door" from his house in great detail to about fifteen people gathered at his friend's house. A messenger arrived much later from Gothenburg and, as Kant notes, in the letters he brought with him "the conflagration was described as Swedenborg had stated it" (quoted in Inglis, 1977, p. 132). There was apparently no way Swedenborg could have known about the fire normally. Edmund Gurney and colleagues published many cases in their 1886 book *Phantasms of the Living*. Since then there have been several other surveys of spontaneous ESP experiences, the prominent among them being a collection of several thousand cases by L.E. Rhine, which is now deposited in the Duke University archives.

The second line of evidence comes from laboratory experiments. The credit for conducting the first major systematic experimental investigation of ESP goes to John Coover (1917/1975) at Stanford University. It was, however, J.B. Rhine (1934) of Duke University who made a sustained scientific claim for the existence of ESP and turned psychical research, an amateur endeavor, into parapsychology, a professional and scientific study of anomalous psychological phenomena. As Mauskopf and McVaugh (1980) note, Rhine gave the field "a shared language, methods, and problems." Rhine's experimental procedures were simple and easy to repeat. He asked his subjects to guess the random order of the cards in a deck of twenty-five consisting of five each of five symbols: circle, cross, wavy lines, square, and star. The Pearce-Pratt experiment by Rhine was the methodological culmination of the early attempts to test for ESP. It had special precautions taken to exclude all types of error, such as two-experimenter controls, independent record keeping, and several hundred yards of distance between the subjects and the target cards, to preclude any sensory cues. With such controls in place, the Pearce-Pratt series gave highly significant results in support of the ESP hypothesis (Rhine & Pratt, 1954).

The Conclusive Experiment

Since the publication of Rhine's monograph, *Extra-Sensory Perception,* in 1934, there have been numerous experimental reports that provided evidence for ESP and PK. There were also reports of experiments that failed to replicate Rhine's results and various kinds of criticism against the evidential value of Rhine's results. Rhine, however, held his ground. He stoutly defended that none of the criticisms invalidate the evidential value of the results without a presumption of fraud on the part of the investigators, an unlikely possibility (see Rao, 1982). In light of the fact that Rhine's results were not universally replicated, there were calls for a conclusive experiment, a completely "fool-proof" study that would control for all conceivable error, including experimenter fraud. I find the demand for an error-proof experiment an impossible goal, at best a tempting mirage, because in retrospect one can always speculate on a possible source of error. If, however, by "conclusive" we make a more modest claim, viz., that it is highly improbable that the results of a successful experiment are due to some possible artifact, then a good case can be made for more than one such experiment in parapsychology.

The REG experiments of Helmut Schmidt (1969), a physicist at Boeing Scientific Laboratories at the time of conducting them, may be cited as an example of well-controlled research that can be accorded the status of a conclusive experiment. Schmidt's experiments were carried out with specially built machines that controlled against artifacts such as recording errors, sensory leakage, subject cheating, and improper analysis of the data. The Schmidt machine, as it has come to be known, randomly selected the targets and automatically recorded both the target selections and subject's responses. The subject's task was to select which of the four lamps in the panel would light up, and then press the corresponding button to indicate the selection. Random lighting of the lamps was achieved by a sophisticated random event generator (REG) with a tiny radioactive source, strontium 90. After extensive testing in control trials, it was determined that the output of the REG did not deviate significantly from chance. The results of each of the three experimental series were highly significant suggesting ESP on the part of the subjects tested.

Replication of ESP Experiments

Whereas a call for a conclusive and completely error-proof experiment seems to be somewhat misconstrued, the emphasis on the need for replication, especially when controversial empirical claims are made, is well placed. If parapsychological phenomena are not replicable, they would hardly excite any scientific interest. Isolated findings and unique events ordinarily hold little interest to scientists unless they lead to or are capable of leading to some kind of general law. ESP as a laboratory effect must be repeatedly observed with reasonable ease in order that it can be studied and understood as a natural phenomenon. Also, the necessity of a foolproof experiment recedes into the background as the phenomenon becomes increasingly replicable.

There is sufficient evidence that several parapsychological phenomena are replicated to a significant degree (see Radin, 1999), although the goal of reproducing the phenomena on demand is yet to be achieved. For example, the REG experiments of the kind carried out by Schmidt have been replicated by several other investigators.

Radin, May, and Thomas (1985) made a survey of all the binary REG experiments published between 1969, when Schmidt first published his results, and 1984. Their review, which included 332 individual experiments, carried out by 30 principal investigators, showed that 71 of them gave statistically significant results in favor of the PK hypothesis. The combined binominal probability of all the studies they reviewed is too small to suggest that these results could be due to chance. The most prominent of the REG replications is a wide range of important experiments carried out by Robert Jahn (1982) and associates (Jahn et. al., 1997; Nelson et al., 1984) at Princeton University. Replication of parapsychological experiments has been observed in the study of the differential effect (Rao, in press), the sheep-goat effect (Palmer, 1971). The differential effect is an often-observed response pattern indicating positive and negative scores in the same experiment by the subject when she is asked to make ESP responses in two different conditions. Sheep-goat effect is the observed tendency of the subjects who believe in the possibility of paranormal phenomena such as ESP to obtain scores in the positive direction while the disbelieving subjects (goats) tend to miss. Other areas in which there is significant evidence for psi include extroversion and ESP (Sargent, 1981; Honorton, Ferrari & Bem, 1998; Palmer & Carpenter, 1998), hypnosis and ESP (Schechter, 1984), ESP in dreams (Child, 1985), and ESP in the ganzfeld (Honorton, 1985; Hyman, 1985; Milton & Wiseman, 1999; Bem, Palmer & Broughton, 2001).

ESP and Sensory Noise Reduction

The results of a number of ESP studies from different areas converge to suggest that the occurrence of ESP may be facilitated by the procedures that result in the reduction of meaningful sensory stimuli and proprioceptive input to the subject. Whatever may be the mechanism by which ESP is mediated, it is reasonable to assume that ESP behaves like a weak signal that must compete for the information processing resources of the organism. In this context, any reduction of ongoing sensory activity may help to improve the chances of detecting the ESP signal. In fact, many of the traditional psychic development techniques, such as the practice of yoga, appear to involve sensory noise reduction procedures.

Experimental results also suggest that meditation may enhance one's ESP ability (Rao et al., 1978). Similarly, relaxation (Braud & Braud, 1974) induced by a variety of techniques, including hypnosis (Fahler and Cadoret, 1958), has been shown to improve ESP scores. There is also substantial evidence to suggest that the absence of meaningful external stimulation in a wakeful state facilitates ESP. The ganzfeld-ESP experiments fall into this category. The ganzfeld is a homogeneous visual field produced by such manipulation as taping two halves of a ping-pong ball over the eyes of the subject and focusing uniform white or red light on the face from about two feet away.

In a typical ganzfeld-ESP experiment, the subject after being in the ganzfeld for about 30 minutes, is asked to report whatever is going on in the mind at that time. The subject's reports are monitored and recorded by an experimenter in another room via a microphone link. A second experimenter, located in a different room isolated from the subject and the monitoring experimenter acts as a sender and looks at a picture for about 15 minutes attempting to "transmit" it to the subject. At the end of the ganzfeld period, the monitoring experimenter gives the subject a set of four pictures with a request to rank each one of them 1 through 4 on the basis of their correspondence to the subject's mental images and impressions during the ganzfeld period. The monitoring experimenter like the subject has no information as to which one of the four pictures is the target picture. Honorton and Harper (1974) published the first ganzfeld-ESP experiment, which provided evidence that the subject's mentation during the ganzfeld matched significantly with the target pictures. By 1985 there were 42 published ganzfeld-ESP experiments of which

19 gave significant evidence of ESP, suggesting that ESP in the ganzfeld is a fairly robust effect. A more recent successful study by Daryl Bem and Honorton (1994) appeared in *Psychological Bulletin*.

This study consisting of 11 experiments involves a setup called autoganzfeld, which utilized complete computer control of the experimental protocol. It is claimed that this procedure meets the "stringent" methodological standards recommended jointly by the critique of parapsychological experiments Ray Hyman and parapsychologist Charles Honorton in their joint communiqué (1986). The results of these experiments provide unambiguous evidence for ESP in the ganzfeld. The latest review of ganzfeld-ESP research is given by Palmer (2003), which again supports the psi hypothesis.

With this much evidence, robust and widespread, we may ask why is it that the scientific community in general is still skeptical about the existence of ESP? First, many of the scientists who express skepticism about ESP have little firsthand knowledge of the evidential experiments in the field. They are guided mostly by the biased criticisms of people like C.E.M. Hansel (1969, 1989). It is doubtful, however, that everyone would accept ESP even if they did read the original reports. Like Hansel, if one accords zero probability for the possibility of ESP, no amount of evidence would be sufficient to establish it. This is the antecedent improbability argument, which leaves no room for ESP in the universe.

While none of the major critics of psi research, including Hansel (1989), Hyman (1985) and Alcock (2003) explicitly endorse the zero probability argument as such their criticisms are generally inspired by the a priori assumption that psi cannot be real and that the proponents of psi subscribe to a nonscientific worldview (Alcock, 1987).

It would appear that only a significant shift in the prevailing scientific paradigm could make ESP congruent with our conception of the universe and make it less dissonant to accept ESP and other paranormal phenomena. Here is where consciousness studies, which suggest the inadequacy of physical explanations to account for all of conscious phenomena, and parapsychological research, concerned with anomalous phenomena, may help to reinforce each other. Meanwhile, ESP researchers continue to struggle to convince the largely skeptical science community with more and hopefully better evidence. Their efforts will at least keep the case for ESP alive. No matter what scientists think, those people who have experienced ESP in their lives, as many have, will continue to believe in ESP. Also, I expect, many others who have not closed their minds to the possibility of ESP on a priori grounds would be convinced of the reality of ESP if they took the time to acquaint themselves with the scientific literature in the field of parapsychology.

Natural Explanations of Psi

Now we may ask, how can we explain the weird phenomena called ESP? The attempted explanations fall into two basic categories, natural and paranormal. Natural explanations of psi fit into two broad categories. First are those that attempt to explain away parapsychological phenomena as no more than artifacts resulting from malobservation and misinterpretation. In the second category are the attempts to explain psi within a physical framework, without invoking any paranormal process. The latter include those that seek to find a place for psi in the physical world as we know it now and those that find it necessary to extend or modify current physical theory, and introduce new physical principles to account for psi.

Skeptical Explanations

The first category is essentially the skeptical stance. The paranormal experiences people report, it is suggested, are due to memory lapses, misconceptions, or simple chance coincidence of events. Some have argued (Spencer-Brown, 1953; Gilmore, 1989) that the statistically significant ESP results are due to inappropriate assumptions about chance expectations. Some skeptics have dismissed all evidence on ad hoc expectations of possible fraud on the part of those involved in the experiment, including the experimenter (Hansel, 1966). A few responsible and constructive critics (Diaconis, 1978; Hyman, 1985) have suggested possible procedural errors. I have not found any of those attempts to explain away parapsychological claims to be any more compelling than the claimed evidence in favor of the phenomena. It has been generally agreed that the statistical procedures employed to evaluate psi experimental data since Rhine's early experiments are basically valid (Camp, 1937). The fraud hypothesis is essentially nonfalsifiable. Critics have generally failed to show that procedural errors account for all of the significant psi results.

Physical Explanations of Psi

In the second category of natural explanations of psi are the physical theories. There are a variety of them, and the more prominent among them are electromagnetic theories and observational theories. The latter are derived from quantum mechanics.

***Electromagnetic Theories*:** On the analogy of the radio, it is suggested that in telepathy some kind of electromagnetic wave transmission may take place between the subject and the agent. According to the Russian scientist B. Kajinsky, the neuron system is vibratory in nature, and there are closed electrical circuits in the nervous system. Every thought, in this view, is accompanied by electromagnetic waves generated in the nervous system; and the waves thus generated in one brain can be afferently received by another brain, resulting in a telepathic kind of experience (see Vasiliev, 1963/1976).

There are several problems with an electromagnetic theory such as the above. Electromagnetic transmission between brains, if it is possible, must be subject to the inverse square law. It is known, however, that telepathic communication decreases with distance. Russian physiologist L.L. Vasiliev (1963/1976) reported that he was not only able to induce hypnotic trance over long distance (1700 km) by telepathic suggestion, but also found no diminishing of the effect when double metal screens were used to shield electromagnetic wave transmission. Moreover, ESP sometimes manifests in the form of clairvoyance, where the information is not generated in the brain but comes from objects that do not have brain-like structures to transmit electromagnetic waves.

Newer versions of electromagnetic theory appear in I.M. Kogan (1966), and Robert Becker (1992). Kogan postulated the existence of "the electromagnetic field of extra-long waves excited by biocurrents" (p. 81). In a similar vein, Becker proposed that extremely low frequency (ELF) waves are assumed to be of such great length that they are not impeded by physical obstructions. In Becker's view, psi signals are not processed by the neurons in the brain, but by a more primitive system involving possibly the glial cells. It is hypothesized that such a primitive communication system consisting of electromagnetic field effects may function more effectively during periods of less turbulent geomagnetic activity. Significant correlations are observed between the occurrence of spontaneous ESP experiences and quiet geomagnetic activity (Persinger, 1985, 1989) and between successful psi tests in the laboratory and low levels of geomagnetic activity at the time the tests were conducted (Berger & Persinger, 1991; Persinger & Krippner, 1989). These findings are cited as evidence in support of the ELF hypothesis.

These correlations are no doubt interesting, but they do not establish that electromagnetic transmission is involved in psi communication. A quiet geomagnetic period may be conducive for the occurrence of psi for other reasons. The ELF hypothesis assumes (1) that human beings are capable of generating ELF waves of sufficient length to penetrate physical barriers and to travel over very long distances, (2) that human subjects can detect such waves, and (3) that ELF waves carry information of the kind required to account for an ESP experience. There is little evidence in support of these assumptions. Moreover, no electromagnetic theory of psi can provide a plausible explanation for precognition (see Stokes, 1997).

Observational Theories: In recent years several physicists have attempted to explain psi with the help of quantum mechanics. These are referred to as observational theories of psi; and the one advanced by Evan Harris Walker (1975) is the best known of them. It may be mentioned that classical mechanics assumes that the future state of a physical system can be determined if we have a complete description of the preceding state of the system. In quantum mechanics, however, a given system develops into one of several possible subsequent states and, according to the widely accepted Copenhagen interpretation, the ultimate description or the state vector of the system incorporates all the potential states. However, when a measurement or "observation" of the system is made, the state vector loses this undefined probabilistic quality and gets "reduced" to one real outcome. Unfortunately, the mathematical formalism of quantum mechanics does not specify what exactly constitutes an "observation", and the resulting difficulties lead to the well known "measurement problem" in quantum mechanics.

One attempt to overcome this problem is to introduce the concept of "hidden variables," the hypothetical factors that reconcile the demands of the deterministic and stochastic conceptions of the development of the state vector. Walker takes off from here and locates the hidden variables in consciousness and equates them with the "will." By "will" Walker means, "that part of man's conscious experience postulated to allow him to assert some control over physical events" (1975, p. 9). In Walker's view, the will is responsible for the collapse of the state vector for a physical system at the quantum level with macroscopically diverse potential states. PK is an instance of such collapse brought about by human volition. Since the hidden variables are "nonlocal" and unconstrained by space-time factors, they are capable of coupling two observers or an observer and an object separated by distance or time. In telepathy, for instance, "the will of the subject and the experimenter act together to select a particular state into which the system is collapsed" (Walker 1975, p. 10). In psi, whether ESP or PK, there is no transfer of energy, but only information is transferred. The magnitude of a psi effect, in Walker's view, depends on the amount of information transferred through the will channel and the amount needed to collapse the state vector of a given system. Walker suggests that quantitative predictions of psi effects can be made based on a detailed analysis of the psi task and the estimate of the observer's abilities to will.

The observational theories of psi are stated to be experimentally testable as they are formulated in mathematical terms. Indeed Walker's theory and other versions of it (Schmidt, 1975, 1984) did stimulate a significant amount of research, especially in the area of PK. However, the validity of any of the versions of the observational theory is yet to be established (Irwin, 1999). Even in the liberal versions of quantum mechanics, it is highly controversial whether the collapse of the state vector involves consciousness in the sense the observational theories require to explain psi. Further, the question of what constitutes an "observation" necessary to bring about the collapse is not answered with any degree of clarity by the theorists in this area. Even granting some validity to observational theories of psi, it is difficult to see them as mere extensions of current physical theory. Walker's theory, for example, sounds clearly dualistic. The "will" and the "hidden variables" seem to have the same ontological primacy as energy, which accounts for the events in the physical world. That the "will" influences only the micro-level quantum systems is beside the point. What is important is that the physical theories seem to assume principles and processes that are not just a mere extension of what is ordinarily understood as physical, but things that are commonly regarded as mental on the Cartesian model. In an important sense, Walker's theory is a significant reversal of the physical model. One could even characterize it as vitalist because the central principle that accounts for psi is located in the "will" of the subject. This shift from the stimulus-centered physical model to a response-oriented approach gives Walker's theory a vitalist look. Note that Walker's theory does not postulate a process by which the energy emanating from the stimulus objects reaches the subject, but rather it looks at the subject and his "will" variables. The development of dualistic physics—this is what this theory attempts to develop—would indeed constitute a paradigmatic shift, and its acceptance would have revolutionary consequences for physics.

***Psychological Models*:** Some attempts have been made by parapsychologists to explain psi within the framework of information processing models (Schmeidler, 1991; Irwin 1979, 1999). In fact, the concept "extrasensory perception" presupposes a perceptual model, that psi operates in a sensory-like fashion, even if it is not mediated by any known senses. This model has shown little promise and attracted only negligible support within the parapsychological community. In a sense it is paradoxical to consider psi as a species of perception and at the same time regard it nonsensory. In fact, lack of any sensory orientation, and absence of any systematic effects of color, shape, size and location of the target on ESP performance clearly suggest that no sensory processing of the kind that goes on in perception is involved in psi. For this reason I argued elsewhere (Rao, 1966) that psi in its cognitive aspect is more like imagination than perception.

H.J. Irwin (1979, 1999) suggested that psi fits better with the information processing model in its ideational mode than in its sensory mode. Irwin recommends a memory model of psi such as the one proposed by W.G. Roll (1966, 1987). Roll suggested that ESP is more like remembering than perceiving. Therefore, the mediation of psi into awareness may involve essentially similar cognitive processing as in memory and be subject to similar laws, e.g., laws of association and frequency. In support of this theory it is claimed that exceptionally successful subjects appear to have excellent memories. At least one experimental study (Feather, 1967) reported a positive correlation between subjects' memory scores and ESP scores. All this is well taken, and there may be some genuine similarities in the way memories and ESP information are mediated into awareness. The memory model, however, does not really explain ESP without invoking something more fundamental and something that is entirely beyond what memory can do. As Irwin himself recognizes, the memory model at best attempts to account for the mediation phase of psi, but not how the subject has access to extrasensory information in the first place. The latter does seem to require a paranormal process.

Paranormal Explanations of Psi

If psi phenomena are anomalous, as they appear to be, and do not fit into physical and psychological models, we will be tempted naturally to conclude that consciousness is not completely contained in our cortical structures or the rest of the nervous system. Indeed, several psychical researchers from F.W.H. Myers (1903/1915) and William James (Murphy & Ballou, 1960) to R.H. Thouless and Weisner (1948) and Larry LeShan (1976) felt it necessary to postulate a hitherto unknown "entity" or a yet unrecognized principle operating when one has a psi experience. Though philosopher Michael Scriven (1962) complained that parapsychology is the reverse of psychoanalysis, with facts only and no theory, there is no lack of speculative theorizing in parapsychology (see Rao, 1977). The primary thrust of the theories in this area has been directed toward explaining how psi may function relatively unaffected by space-time constraints. As mentioned, many theorists felt it necessary to postulate new entities that can transcend space and time or new media that enable an individual to interact with the environment without being limited by space-time constraints. Since there are too many theories to review here, we may consider two of them to illustrate the kind of theorizing that goes on in parapsychology to provide paranormal explanations of psi.

Subliminal Self: F.W.H. Myers in his monumental work *Human Personality and Its Survival of Bodily Death* (1903/1915) has attempted to lay the foundation for a comprehensive science of consciousness. Myers believed that consciousness is more than what we are ordinarily aware. Our normal consciousness, which Myers called supraliminal consciousness, "does not comprise the whole of consciousness or of the faculty within us. There exists a more comprehensive consciousness, a profounder faculty" (Myers, 1903/1915, p. 12), which he refers to as subliminal or ultramarginal consciousness. In this view, it is like radiation beyond the visible spectrum. The states of consciousness that we are normally aware of are like those that fall within the visible spectrum, i.e., between violet and red. According to Myers, consciousness can be represented "as a linear spectrum whose red rays begin where voluntary muscular control and organic sensation begin, and whose violet rays fade away at the point at which man's highest strain of thought of imagination merges in reverie and ecstasy" (p. 18). Thus, at either end of the consciousness spectrum Myers senses a wide variety of states that go beyond sensation and intellect.

The ultramarginal consciousness, which for the most part remains only as potential, is what Myers calls the *subliminal self*. "I mean by the subliminal self," writes Myers, "that part of the self which is commonly subliminal. And I conceive also that no self of which we can have cognizance is in reality more than a fragment of a larger Self, — revealed in a fashion at once shifting and limited through an organism not so framed as to afford its full manifestation" (Myers, 1903/1915, p. 15).

In his conception of the subliminal self, Myers postulates an "inward extension of our being", as James put it, "cut off from common consciousness by a stream or diaphragm not absolutely impervious but liable to leakage and to occasional rupture" (Murphy & Ballou, 1960, p. 230). However, Myers was vague as to how the subliminal self makes contact with the "cosmic" environment to bring about paranormal awareness. Various alternatives suggest themselves: (1) The subliminal selves are but waves in the sea of consciousness, pervasive and all compassing; (2) the subliminal self is discrete and discontinuous from others but it can interact with them because all of them are submerged in a common medium of consciousness; or (3) the subliminal self is a discrete center of consciousness inherently nonlocal and hence capable of interacting with others without being limited by space or time. The vagueness of Myers' formulation had the merit of inspiring a number of subsequent thinkers ranging from William James to Jan Ehrenwald (1947).

***The Shin Theory*:** The British psychologist R.H. Thouless and his associate B.P. Weisner advocate a radical dualistic postulation of the mind-brain relationship. Thouless and Weisner (1948) suggest that an entity, which they call "shin", is involved in all our cognitive processes, normal as well as paranormal. They argue that in all normal processes of volition and perception the shin functions through the medium of the brain and the nervous system. Anomalous cognitive experiences occur when the shin bypasses the brain and the nervous system and directly interacts with the environment. In this view, the shin becomes aware of brain states by a clairvoyant type of monitoring of neural activity. Similarly, a psychokinetic type of influence of neural events by the shin results in volitional activity. In normal perception, stimuli from the object act on the sensory part of the nervous system. Shin is informed by the processes in the nervous system and the brain. In clairvoyance, however, direct connections are established between the shin and external objects without the mediation of the brain and the nervous system. Thus psi cognitions are no more supernormal than ordinary perceptions, but they are, as Thouless and Weisner put it, "exosomatic forms of processes which are normally endosomatic" (1948, p. 199).

It would appear that the shin is more like the mind in a state of pure consciousness or awareness-as-such. The question remains, however, whether the shin is a discrete center of consciousness or a common medium that envelops the multitude of beings with cognitive abilities. Shin as a discrete entity is consistent with the notion of plurality of selves. Plurality of nonlocal selves, whose normal cognitive processes manifest only in association with particular brain structures may be merely functional rather than intrinsic. The question whether the shin is one or many is relevant only at the level at which the shin functions in association with the brain.

Charles Honorton and Lawrence Tremmel (1979) claimed support for the shin theory when they found a significant positive correlation between the subjects' PK scores and their ability to control their own brain waves. An attempted replication of this finding did not succeed (Varvoglis & McCarthy, 1986). In fact, significant PK results were obtained in this study only in the trials in which the subjects' performance on the brain-wave control task was poor. This finding is clearly contrary to what Honorton and Tremmel reported. We can still argue, however, that these findings do not contradict the shin theory, if we assume that the shin has a limited capacity for attention, and that when it is diverted to a normal task there may be less or no success in a paranormal task (Stokes, 1997).

Many of the physical theories of psi have testable implications, but they are not supported by the relevant data. The paranormal theories may have intuitive appeal; however it is difficult to generate testable hypotheses from them. The thing that distinguishes psi research from folklore and occult claims is the commitment to scientific method. Consequently, a theory that permits little deductive development and makes no verifiable predictions can hardly be of any legitimate interest to parapsychologists. This is the problem that haunts most paranormal theories.

Consciousness and Psi

From the preceding discussion of consciousness and psi, it is clear that they share similar conceptual and methodological problems. How can we conceive of and study phenomena and processes that may not be reduced to physical and biological states? What kinds of observations and measurements can we make of them? More importantly, while addressing questions about the role of the physical brain in cognition and action, the subjectivity aspect of consciousness in general and the evidence for psi in particular raises serious doubts about the adequacy of the materialist conception of the universe and our place and role in it. Parapsychology has attempted to naturalize the supernatural by successfully employing scientific method. In so doing it has raised questions about the very assumptive base of science. What parapsychology has thus attempted to do may be methodologically relevant to consciousness studies. If some aspects of consciousness do not indeed fit into the physical framework of our being and consequently do seem to involve extraphysical processes, can we ever understand these processes? Or are we destined to be "cognitively closed" to them, as some have despaired? In other words, is it possible to have a naturalistic understanding of the phenomena and processes that may not be translated into physical terms? Does the postulation of extraphysical processes necessarily lead to a radical dualistic metaphysics and all the associated difficulties of accounting for their interaction? If there is a transcendental (extraphysical) realm of being, as most religious experiences are believed to attest (i.e. so-called pure conscious events), how can we account for our dual citizenship in the physical and extraphysical worlds? These issues confront both psi research and consciousness studies. I believe, however, that parapsychology, seen as constituting an interface between the two realms, may provide useful conceptual and methodological tools for bridging the apparent gulf between them.

ESP and other psi phenomena are characterized as anomalous precisely because they are considered to be inconsistent with the scientific worldview and are seen as a kind that cannot occur in a universe that is fully described in physical terms and explained by physical laws. Paradigmatically, it is assumed to be self-evident that it is impossible for one to have any awareness of a physical event or a material object without being in sensory contact with that event or object, and that one's mind/consciousness cannot directly cause any changes in the material world, other than changes in one's own brain (Broad, 1953). These assumptions rule out a priori the possibility of ESP or PK. Moreover, if the cases suggestive of reincarnation are indeed what they are claimed to be by the investigators (Stevenson, 1987), then the identity theory which equates conscious states with the brain states would lack all legitimacy. Thus paranormal awareness will have a decisive role in settling the question whether all forms of awareness can be realized by physical systems. The reality of psi is evidence against any materialistic conception of consciousness. Inasmuch as the brain's capacity to receive information is strictly limited to that which is received via the neural pathways, ESP is simply beyond the reach of the brain. Again, PK demonstrates that minds/consciousness can do things that no brains can do. One may argue, however, that new advances in physical theory may accommodate paranormal awareness. In the "weird wonderland" of subatomic and super galactic physics, as Arthur Koestler (1972) put it, phenomena which appear more "occultish" than psi are known to exist. However, as Keith Campbell (1970), no friend of parapsychology, remarks on this point: "The doctrine that some science, we do not know which, is adequate to support a Central-State doctrine of the mind, is so vague and so weak that it is not worth holding or discussing" (p. 97).

That psi phenomena do not fit into the physical framework is, of course, no sufficient reason to embrace a radical dualism. Radical dualism on its part creates new problem by postulating entities that resist empirical testing. If the physical and nonphysical are considered to be so radically different as to have separate domains of existence, there is little hope of understanding how they may function in association with each other. In reality the normal and paranormal function together. Psi events take place in the physical world; and they are experienced by people with brains and bodies. Psi phenomenon, even if they were to involve processes qualitatively and fundamentally different from the known physical processes, manifest in such a way that we can study them in a naturalistic manner through observation and experiment. Therefore, psi may be usefully thought of as constituting an interface between the two fundamental processes. Conceived as threshold phenomena that link two disparate realms, psi may give us insights that could lead us to a common ground covering the two processes. We are thus led to the domain of process dualism rather than entity dualism.

Normal and Paranormal Processes

So far we have described "paranormal" as that which transgresses what are believed to be the basic limiting principles that govern the physical framework of the universe and our place in it. When we use such expressions as extraphysical and nonphysical to convey the sense that paranormal phenomena are such that they cannot be contained in principle within a physical system, we are saying what the paranormal is not, and not what it is. The description is thus negative in its import. It casts the normal and the paranormal in contrasting roles and tends to set them in opposition in an "either-or" mode. Consequently it runs the risk of clouding their possible complementary function. In an attempt to throw some positive light on it, we may now allow ourselves to make some speculative assumptions about the paranormal in its relation to awareness.

In normal awareness, such as perceptual awareness, we postulate (1) a subject who has awareness, (2) the object of awareness, and (3) a process of awareness. The object is related to the subject through the instrumentality of sensory mediation and the processing in the brain. The resultant awareness is thus constructed to represent the world to us. In this situation the subject and the object are seen as divided and separate, but related by the mediation of the senses, the nervous system and the brain's functions. If our sensory mechanisms and the cerebral processes were to be different from what they are, our perception of the world would be very different indeed. What we have in our perceptions of the world are the appearances of reality and not the reality itself. In that sense the "things-in- themselves" remain forever "unknown".

Now, consider the possibility that a subject is in direct contact with and has unmediated access to the object. Awareness arising out of such unmediated access would be an instance of what we referred to as paranormal awareness. Such awareness would indeed be different in kind from normal awareness. In normal perceptions, for example, the object is represented, and it is these representations and our reflections on them that give us the "knowledge" of the object perceived. Since all of us have similar sensory systems and cortical structures that process the energy patterns emanating from the object in similar ways, we have shared representations that give us a sense of objectivity about them. Also, we make assumptions about reality as it is represented to us and we test these assumptions by means of other representations and thus attempt to verify and validate our assumptions about the objects of representations and the assumed nature of reality. Our knowledge of reality is thus indirect, mediated and in a sense inferential. On the other hand, the awareness we would have, if we had unmediated access to the object, would be direct and not represented via sensations, images and thoughts. Instead, such unmediated awareness would acquaint us directly with the object and we would have an awareness of the object in itself. In a sense, it would be knowing *by being*. In other words, the relation between the subject and the object of awareness is not representational and reflective but reflexive, one of identity.

Awareness via sensory representations is "knowing" by *description;* unmediated awareness is awareness by direct *acquaintance;* or, to put it in another way, it is awareness *by being.* The former approximates to what we generally label as information. The latter may be thought of as *revelation* or *realization* as distinguished from *knowing* or *understanding.* Information is cognitively processed awareness whereas realization or revelation is consciousness-as-such, an experience by being. In paranormal processes, then, there is no information flow; and in a significant sense it is contentless awareness inasmuch as the content of our cognitions is always of a sensory nature.

We may speculate further that there is a primordial existential state, the ground condition, an amorphous and undifferentiated state in which knowing and being are indistinguishable, as they coalesce into a single state. With the development of the sensory and the cortical systems, knowing and being branch off and are differentiated. Awareness becomes a state of knowing instead of an experience of being. Consequently, we tend to be completely dependent on cortically processes and sensory mediated awareness, and lose touch with the awareness by being. Normal awareness is awareness of representations; paranormal awareness is awareness by being. The latter involves reflexive identity between the subject and the object, and their relationship may be conceived as *teleological.* The former involves subject's reflection and the object's representation. The subject-object relationship is *causal.*

If paranormal awareness is conceived to be awareness as such without content, how is it different from a state where there is no awareness at all? Accustomed, as we are, to depend almost exclusively on mediated awareness, it is only natural to think that it is the only kind of awareness there is. Recall that our perceptions are only appearances and their genuineness and veridicality are tested by appeal to inter-subject consensus and other assumptions we make of reality. Awareness as such, on the other hand, does not require such cross-validation because it is unmediated awareness of being, a relationship of identity and direct acquaintance, as distinct from descriptive awareness by representation. Its validity is reflexive and possibly self-certifying, unlike the awareness of cognitive awareness, which is reflective and consensual. Awareness as such, by assumption, does not involve any sensory processes, has no representational content, and yet it is believed to influence our lives in important ways.

In some of the Eastern traditions, awareness-as-such or pure consciousness is not taken as an intellectual abstraction, but presented as an empirical claim. The entire gamut of yogic practices and a host of other psychic development strategies are based on that claim. Therefore, the question whether awareness-as-such really exists need not be answered on theoretical grounds. Pure consciousness is not a mere logical presupposition; its existence is considered a fact of experience. I would like to add that awareness as such involves a state of *realization* as distinct from simple knowing and understanding. While experiencing sensory awareness, it is possible to dissociate cognition and conduct, because they are distinct at this level. One may know, for example, that smoking is bad for health, and yet continue to smoke. In a state of realization, however, there is no room for such dissociation. Knowing and being blend into one state and become inseparable. This is best exemplified in the Upanishadic saying, "to know Brahman is to be Brahman." The lives of true saints and those who had genuine near-death and "peak" experiences, that were life transforming, may exemplify rudimentary states of realization.

Considered in this manner, the normal and the paranormal may indeed be complementary processes. I venture to speculate further that the basic principles underlying fundamental discoveries and the inspiration for artistic excellence may have an intuitive genesis. Their validation via scientific formulation or evaluation by art criticism, however, is a consequence of rational reflection. In fact we may conceive that the basic values that govern our conduct in general seem to pervade across cultures and persist over the ages are likely given to us intuitively. I adhere to the notion that there is nothing purely random in nature or in our behavior. Our behaviors, as well as the course of nature, are determined by normal or paranormal processes or a combination of both. It is likely that the apparent random behavior, where we find no normal causation, may have a paranormal source. Take for example the case of evolution. There are no generally agreed on probability formula among mathematicians and biologists to satisfactorily explain how our biosphere has evolved the way it did by random mutation and selection. The inherent difficulties in the classical Darwinian position has led at least one eminent biologist, Sir Alister Hardy (1965) to suggest that a paranormal system may interact with a normal physical system in the evolutionary process and thus account for the gaps left by the classical selection theory. Again, the distinction between explicate and implicate organizations made by David Bohm (1973) is similar to the one we have made between the normal and the paranormal processes.

The Two Aspects of Psi

ESP and PK may be seen as interactive phenomena, a combined product of the normal and paranormal processes. ESP exemplifies one of the ways in which awareness *by being* becomes mediated awareness. Unlike awareness as such, ESP has content, which means that it conveys information. Unlike in normal process, however, in ESP there is no information flow from the object to the subject. The ESP subject does not receive information from the target in the manner one receives information from the stimulus in perception. The information is generated from within; the *being* experience is transformed into an information state. Thus the paranormal finds expression in the normal cognitive processes.

ESP then needs to be explained at two levels – the level of being and the level of knowing. At the level of being, the paranormal process establishes the source of psi in the subject. Then at the level of knowing psi is cognitively processed so as to manifest in one of the familiar forms. L.E. Rhine's (1961) analysis of the spontaneous cases revealed four basic forms of psi occurrence. They are (a) realistic dreams, (b) unrealistic dreams, (c) hallucinations, and (d) intuitions. In addition, laboratory studies have shown that ESP may manifest in a covert fashion as awareness does in subliminal perception; and sometimes psi information is revealed via physiological changes in the subject (Figar, 1959; Tart, 1963; Dean & Nash, 1967; Braud, Shafer, & Andrews, 1990; Wiseman & Schlitz, 1997).

G.N.M. Tyrrell and L.E. Rhine among others recognized that psi functions at two levels. Tyrrell (1947) suggested that ESP phenomena first occur at the subliminal level and then they are obliged "to pass through the bottleneck at the threshold if they are to reach the normal consciousness" (p. 331). They pass over the threshold by making use of what Tyrrell called the "mediating vehicles," which according to him include dreams, sensory hallucinations, automatic writing, mental images, and strong emotions. Following Tyrrell, L.E. Rhine (1965) hypothesized that psi involves a two-stage process. First is the paranormal stage about which we know so little. The second stage involves the normal cognitive processing, similar to the psychodynamic processes by which the unconscious material finds its way into subjective awareness. She points out that cases of incomplete and distorted psi information, including psi-missing in which the subject significantly misses the target (beyond chance expectation), while attempting to hit, are better understood in terms of the two-stage process.

In this context it would be of interest to note the striking similarities between ESP and subliminal perception (SP). In fact a number of researchers were sufficiently impressed by their similarities as to undertake investigations to explore the relationship between SP and ESP (Rao & Rao, 1982; Krietler & Krietler, 1973). Norman Dixon (1979) identified several areas of contact between SP and ESP. He pointed out that a number of variables like motivation, memory, altered states of consciousness, such as relaxation and dreams, right hemispheric functioning, etc., have similar influence on both SP and ESP. Gertrude Schmeidler (1971) also observed that "whatever psychological laws apply to the processing of ambiguous sensory material will apply also to the processing of ESP information" (p. 137). Another psi researcher Charles Honorton (1976) wrote: "Both subliminal and psi influences are facilitated by internal-attention states, both are subject to subtle experimenter effects and situational factors, and both involve the transformation and mediation of stimulus influence through ongoing mentation processes" (pp. 215-216). It is also suggested that ESP and SP may represent primitive brain functions (Ehrenwald, 1979). Freud himself (1953) expressed the view that telepathy "comes about particularly easily at the moment at which an idea emerges from the unconscious or, in theoretical terms, as it passes over from the 'primary' process to the 'secondary process'" (p. 89).

Double Aspects of Consciousness

By accepting, then, that there are normal and paranormal phenomena and that the latter are intrinsically incapable of being contained within a physical system, are we favoring radical dualist metaphysics of substantive independence of body and mind? It need not be so. That the normal and the paranormal processes appear to be two aspects of psi suggests that they may be complementary aspects of one and the same reality. Characterizing them as physical and nonphysical or material and immaterial is something that is better avoided than addressed at this point, because such dichotomous characterization will create additional problems without helping to solve any. However, the reality of psi decisively stands against all materialistic doctrines, whether state-central materialism or neural identity theory, as they are formulated now. At this stage, a double aspect theory appears in a better light. Whether the underlying reality of which the normal and the paranormal are two fundamental aspects is material or nonmaterial is perhaps, as Douglas Stokes (1997) says, is "a matter of semantics rather than substance" (p. 140).

The British philosopher C.D. Broad (1925/1951) proposed a theory of the mind that incorporates the normal and the paranormal processes into a single system. According to his compound theory, the mind is not a single substance, but a compound of two factors—the psychic factor and the bodily factor. In other words, the mind is the composite of consciousness and the brain. He suggests that mental functions such as perception, reasoning and remembering are not the products of either of the factors alone. Just as a chemical compound possesses characteristics that do not belong individually to any of the constituent elements of the compound, the functions of the mind are not found solely in one or another of the constituent elements. In functional terms, the two factors in Broad's theory are the normal and paranormal processes of the mind. The shin theory proposed by Thouless and Weisner discussed earlier, leaving aside its dualistic overtone, may be interpreted as a dual process theory. Shin is the Hebrew word for mind. It would simplify matters considerably, if the normal and paranormal aspects are regarded as two processes of the mind, instead of assuming that the shin is a nonphysical entity in virtue of which psi becomes possible.

A similar point has been made more forcibly in some of the classical Indian theories of the mind (see Chennakesavan, 1991). In Samkhya-Yoga system, for example, reality is seen as governed by two fundamental principles – consciousness (*purusha*) and matter (*prakriti*). When there is a conjunction between consciousness and a material form, a mind is formed. The mind is a functional trap where nonconscious material forms become conscious experiences, and inert and characterless consciousness assumes form and manifests activity. When consciousness is thus trapped we have subjective experience, which tends to bind consciousness more and more firmly to sensory processes. The mind functions via *vrittis*, the sensory modes. This is, however, not an irreversible process. By rendering the sensory and related systems quiescent through meditation and other techniques, it is believed, one can attain a state of *samadhi* in which the mind can experience consciousness-as-such, without the limitations imposed by the sensory system (Rao, 2005).

Even in Buddhism we find a similar approach. In Buddhism there is of course no substantive soul or mind. What we have is only consciousness, which is seen as a dynamic process. Consciousness is the stream of being and has subliminal and supraliminal existence and is governed by paranormal as well as normal processes. The supraliminal is our normal cognitive stream. In the manifest stream, consciousness, in the words of Buddhaghosa (1923) is "that which thinks of its object" (p. 148). It gives us discriminative information. The subliminal stream, the *bhavanga*, on the other hand, is a thought-free state. It is described as "the cause, reason, indispensable condition, the sine qua non of our existence, but without which one cannot subsist or exist" (Aung and Rhys Davids, 1929, pp. 265-266). The *bhavanga* and the cognitive consciousness are thus the two aspects of the functional mind corresponding to the normal and paranormal distinction we made.

So, we see in the Indian thought, whether one subscribes to dualism of the sort espoused by Samkhya-Yoga theorists, the monism of Advaita Vedanta, or Buddhistic functionalism, the mind is considered an interface between the normal and the paranormal, the phenomenal and transcendental aspects of being. Mind is the instrumentality of our experience; it is our reality connection. In its normal phase the mind with its associated cortical and sensory-motor systems connects us to the objective world and we have cognitive awareness of it. In its paranormal phase, the mind participates in pure consciousness and becomes one with reality, giving rise to transcendental realization.

Conclusion

Consciousness refers to a set of heterogeneous phenomena. These superficially diverse phenomena fall broadly into four categories – (1) primary awareness, (2) paradoxical awareness, (3) pathological awareness, and (4) paranormal awareness. They manifest in two forms – (1) the explicit and (2) the implicit. They appear to be governed by two fundamental processes – (1) the normal and (2) the paranormal, which do not constitute an incongruous dyad. It is suggested that they may be seen as mutually complementary processes.

The normal processes of awareness are those in which awareness is mediated by sensory processes, the nervous system and the brain. They admit naturalistic explanations within the framework of a physical system. The paranormal processes, however, resist such explanations calling for fundamentally different assumptions. In paranormal awareness there is no sensory mediation. The awareness is direct. The subject and the object have an identity relationship. The subject realizes the object in his/her own being. A process we called *awareness by being*, distinguished from *awareness by knowing*. Awareness by being involves accessing pure consciousness. It is a state of awareness-as-such. It is a contentless and nonrepresentational state. Spontaneously on rare occasions and often by disciplined practice (if we may trust the yogic claims) a pure conscious event may manifest in a cognitively processed form. The mind as an interfacing instrumentality is involved in both the normal and paranormal processes. It is also the source of interplay between the two processes.

There are good reasons to believe in the reality of psi. Carefully conducted experiments and frequently reported spontaneous experiences provide persuasive evidence in support of ESP and PK. The known characteristics of psi suggest that psi involves a two-stage process. One of the stages is conceived to be something that may not be realized by a physical system. The other is normal cognitive processing. Inasmuch as psi thus involves normal and paranormal processes, it may be usefully thought of as gateway between the two.

If ESP is real and can be investigated by deploying scientific methods, psi research may have profound conceptual, methodological and theoretical implications for consciousness studies and vice-versa. The fundamental distinction between awareness *by being* and awareness *by knowing* can play a crucial role in adding a new dimension to consciousness studies. It is important that researchers recognize that psi is one kind of awareness and that there is congruence and homogeneity among what at first appear to be a heterogeneous "hodgepodge" of disparate items of consciousness. Once there is such recognition, the researchers would begin to appreciate the important aspects in which they may benefit by learning how consciousness manifests at implicit and explicit levels and how the normal and the paranormal interact. An understanding of the interaction between the two would help to explain the subjective, "what it is like," experience and other aspects of consciousness that seem to defy physical explanations. As researchers learn more about the physical and psychological variables related to the occurrence of psi experiences, hopefully useful common ground between psi and other forms of awareness would be found.

Also, recognition of the reality of psi would take the wind out of the sail of state-central materialism and neural identity theories. Whether this necessarily leads us to favor radical dualism is, however, doubtful. A double aspect theory of the mind, which does not commit to either materialism or spiritualism, could account for all types of awareness including psi without the additional problems that radical dualism entails. Thus process dualism appears to be less problematic than entity dualism. Many classical Indian theories of mind consider the mind as matter in its subtlest form with normal and paranormal attributes. This line of thought deserves to be explored further with a naturalistic bias.

References

Alcock, J.E. (2003), 'Give the null hypothesis a chance: Reasons to remain doubtful about the existence of psi', *Journal of Consciousness Studies*, **10** (6-7), 29-50.

Alcock, J.E. (1987), 'Parapsychology: Science of the anomalous or search for the soul?', *Behavioral and Brain Sciences*, **10**: 553-65.

Armstrong, D.M. (1968), *A Materialistic Theory of the Mind* (London: Routledge and Kegan Paul).

Armstrong, D.M., and Malcolm, N. (1984), *Consciousness and Causality: A Debate on the Nature of the Mind* (Oxford: Basil Blackwell).

Aung, S.Z. and Rhys Davids, C.A.F (ed. and trans.) (1929), *Compendium of Philosophy* (London: Oxford University Press).

Bauer, R.M. (1984), 'Autonomic recognition of names and faces in prosopagnosia: A neuropsychological application of the guilty knowledge test', *Neuropsychologia*, **22**, pp. 457-469.

Bechtel, W. and Abrahamsen, A. (1991), *Connectionism and the Mind: An Introduction to Parallel Processing in Networks* (Oxford: Basil Blackwell).

Becker, R.O. (1992). 'Electromagnetism and psi phenomena', *Journal of the American Society for Psychical Research*, **86**, pp. 1-17.

Beloff, J. (1962), *The Existence of Mind* (London: MacGibbon and Kee).

Bem, D.J. and Honorton, C. (1994), ' Does psi exist? Replicable evidence for an anomalous process of information transfer', *Psychological Bulletin*, **115**, pp. 4-18.

Bem, D.J., Palmer, J and Broughton, R.S. (2001), 'Updating the ganzfeld data base: A victim of its own success', *Journal of Parapsychology*, **65**, pp. 207-218.

Berger, R.E. and Persinger, M.A. (1991), 'Geophysical variable and behavior: LXVII. Quieter annual geomagnetic activity and larger effect size for experimental psi (ESP) studies over six decades', *Perceptual and Motor Skills*, **73**, pp. 1219-1223.

Block, N. (1995), 'On a confusion about a function of consciousness', *Behavioral and Brain Sciences*, **18**, pp. 227-247.

Blumenthal, A.L. (1977), *The Process of Cognition*, (Englewood Cliffs, NJ: Prentice-Hall).

Bohm, D. (1973), 'Quantum theory as an indication of a new order in physics. Part B. Implicate and explicate order in physical law', *Foundations of Physics*, **3** pp. 139-168.

Bornstein, R.F. and Pittman, T.S. (Eds.) (1992), *Perception Without Awareness: Cognitive, Clinical and Social Perspectives* (New York: Guilford Press).

Braud, L.W. and Braud, W.G. (1974), 'Further studies of relaxation as a psi-conducive state', *Journal of the American Society for Psychical Research*, **68**, 229-245.

Braud, W., Shafter, D., and Andrew, S. (1990), 'Electrodermal Correlates of Remote Attention: Autonomic Reactions to an unseen Gaze', *Proceedings of the Parapsychological Association 33rd Annual Convention*, pp.14-28.

Brentano, F. (1973), *Psychology from an Empirical Standpoint*, trans. A. C. Rancurello (New York: Humanities Press; Originally published in 1925).

Broad, C.D. (1951), *Mind and Its Place in Nature* (New York: Humanities Press; Originally published, 1925).

Broad, C.D. (1953), *Religion, Philosophy and Psychical Research* (New York: Harcourt Brace).

Buddhaghosa (1923), *Visuddhimagga* (*The Path of Purity*), 3 Vols., trans. P.M. Tin (London: Oxford University Press).

Camp, B.H. (1937), 'Statement under "Notes"', *Journal of Parapsychology*, **1**, pp. 305.

Campbell, K. (1970), *Body and Mind* (London: Macmillan).

Chalmers, D.J. (1996), *The Conscious Mind: In Search of a Fundamental Theory* (New York: Oxford University Press).

Chennakesavan, S. (1991), *Concept of Mind in Indian Philosophy*, (Delhi: Motilal Banarsidass).

Child, I.L. (1985), 'Psychology and anomalous observations: The question of ESP in dreams', *American Psychologist*, **40**, pp. 1219-1230.

Churchland, P. and Churchland, P.S. (1982), 'Functionalism, qualia, and intentionality. In *Mind, Brain and Function*, eds. J. Biro & R. Shahan (Norman: University of Oklahoma Press).

Coover, J.E. (1975), *Experiments in Psychical Research* (New York: Arnopress; Originally published in 1917).

Dean, E.D. and Nash, C.B. (1967), 'Coincident plethysmograph results under controlled conditions', *Journal of the Society for Psychical Research*, **44**, pp. 1-14.

Dennett, D.C. (1991), *Consciousness Explained* (New York: Little Brown).

Dennett, D.C. (1997), 'Quining qualia'. In *The Nature of Consciousness: Philosophical Debates*, eds. N. Block, O. Flanagan, and G. Guzeldere (Cambridge, MA: MIT Press).

Diaconis, P. (1978), 'Statistical problems in ESP research', *Science*, **201**, pp. 131-136.

Dixon, N.F. (1979), 'Subliminal perception and parapsychology: Points of contact', *Parapsychology Review*, **10**, pp. 1-6.

Ehrenwald, J. (1947), *Telepathy and Medical Psychology* (London: George Allen & Unwin).

Ehrenwald, J. (1978), *The ESP Experience: A Psychiatric Validation* (New York: Basic Books).

Fahler, J. and Cadoret, R.J. (1958), 'ESP card tests of college students with and without hypnosis', *Journal of Parapsychology*, **22**, pp. 125-136.

Farah, M.J. (1997), 'Visual perception and visual awareness after brain damage: A tutorial overview'. In *The Nature of Consciousness: Philosophical Debates*, eds. N. Block, O. Flanagan, and G. Guzeldere (Cambridge: MA: MIT Press).

Feather, S.R. (1967), 'A quantitative comparison of memory and psi', *Journal of Parapsychology*, **31**, pp. 93-98.

Figar, S. (1959), 'The application of plethysmography to the objective study of so-called extrasensory perception', *Journal of the Society for Psychical Research*, **40**, pp. 162-172.

Forman, R.K.S. (1990), 'Introduction: Mysticism, constructionism, and forgetting. In *The Problem of Pure Consciousness: Mysticism and Philosophy*, ed. R.K.C. Forman (New York: Oxford University Press).

Freud, S. (1953), 'Dreams and telepathy' In *Psychoanalysis and the Occult*, ed. G. Devereaux (New York: International Universities Press).

Gilmore, J. B. (1989), 'Randomness and the search for psi'. *Journal of Parapsychology*, **53**, pp. 309-340.

Gurney, E., Myers, F.W.H., and Podmore, F. (1886), *Phantasms of the Living*, Vols. 1 & 2 (London: The Society for Psychical Research and Trubner & Co).

Haber, R.N. and Erdelyi, M.H. (1967), 'Emergence and recovery of initially unavailable perceptual material', *Journal of Verbal Learning and Verbal Behavior*, **66**, pp. 618-628.

Hansel, CE.M. (1966), *ESP: A Scientific Evaluation* (New York: Scribners).

Hansel, C.E.M. (1989), *The Search for Psychic Power: ESP & Parapsychology Revisited* (Buffalo, NC: Prometheus Books).

Hardy, A.C. (1965), *The Living Stream* (London: Collins).

Hilgard, E.R. and Hilgard, J.R. (1983), *Hypnosis in the Relief of Pain* (Los Altos, CA: W. Kaufman).

Honorton, C. (1976), 'Has science developed the competence to confront claims of the paranormal? In *Research in Parapsychology,* 1975, eds. J.D. Morris, W.G. Roll, and R.L. Morris (Metuchen, NJ: Scarecrow Press).

Honorton, C. (1985), 'Meta-analysis of ganzfeld research: A response to Hyman', *Journal of Parapsychology,* **49**, pp. 51-91.

Honorton, C. and Harper. S. (1974), 'Psi-mediate imagery and ideation in an experimental procedure for regulating perceptual input', *Journal of the Society for Psychical Research,* **68,** pp.156-68.

Honorton, C. and Tremmel, L. (1979), 'Psi correlates of volition: A preliminary test of Eccles' "neurophysiological hypothesis" of mind-brain interaction'. In *Research in Parapsychology,* 1978, ed. W.G. Roll (Metuchen, NJ: Scarecrow Press).

Honorton, C., Ferrari, D.C. and Bem, D.J. (1998), 'Extraversion and ESP performance: A meta-analysis and new confirmation, *Journal of the American Society for Psychical Research,* **68**, pp. 156-168.

Hyman, R. (1985), 'The ganzfeld ESP experiment: A critical appraisal', *Journal of Parapsychology,* **49**, pp. 3-49.

Hyman, R. and Honorton, C. (1986), 'A joint communiqué: The psi ganzfeld controversy'. *Journal of Parapsychology,* **50**, 351-364.

Inglis, B. (1977), *Natural and Supernatural: A History of the Paranormal from Earliest Times to 1914* (London: Hodder & Stoughton).

Irwin, H.J. (1979), *Psi and the Mind: An Information Processing Approach* (Metuchen, NJ: Scarecrow Press).

Irwin, H.J. (1999), *An Introduction to Parapsychology* (Jefferson, NC: McFarland).

Jahn, R.G. (1982), 'The persistent paradox of psychic phenomena: An engineering perspective', *Proceedings of the IEEE,* **70**, pp. 136-170.

Jahn, R.G., Dunee, B.J., Nelson, R.D., Dobyns, Y.H. and Bradish, G.J. (1997), 'correlations of random binary sequences with pre-stated operator intention: A review of a 12-year program', *Journal of Scientific Exploration*, **11**, 345-367.

James, W. (1952), *The Principles of Psychology* (Chicago: Encyclopedia Britannica; Originally published in 1890).

Jung, C.G. (1954), 'On the nature of psyche'. In. *Collected Works of C.G. Jung* (Vol.8) ed. H. Read et al., tans. R.F.C. Hull (Princeton, NJ: Princeton University Press; Originally published 1919).

Jung, C.G. and Pauli, W. (1955), *The Interpretation of Nature and the Psyche: Synchronicity and the Influence of Archetypal Ideas on the Scientific Theories of Kepler* (New York: Pantheon).

Kim, L. (1985), 'Psychophysical laws'. In *Action and Events*, eds. LePone and B. McLaughlin (Oxford: Blackwell).

Kihlstrom, J.F. (2003), 'The cognitive unconscious'. In *Essential Sources in the Scientific Study of Consciousness*, eds. B.J. Baars, W.P. Banks, and J.B. Newman (Cambridge, MA: MIT Press).

Kinsbourne, M. (1988), 'Integrated field theory of consciousness'. In *Consciousness in Contemporary Science*, eds. A.J. Marcel and E., Bisiach (Oxford: Clarendon Press).

Koestler, A. (1972), *The Roots of Coincidence* (New York: Random House).

Kogan, I.M. (1966), 'Is telepathy possible?' *Telecommunications and Radio Engineering*, **21**, pp. 75-81.

Kreitler, H. and Kreitler, S. (1973), 'Subliminal perception and extrasensory perception', *Journal of Parapsychology*, **37**, pp. 163-188.

Kunst-Wilson, W.R. & Zajonc, R.B. (1980), 'Affective discrimination of stimuli that cannot be recognized', *Science*, **207**, pp. 557-558.

Ladd, G. (1909), *Psychology: Descriptive and Explanatory* (New York: Scribner's Sons).

LeShan, L. (1976), *Alternate Realities* (New York: M. Evans & Co).

Madell, G. (1988), *Mind and Materialism* (Edinburgh: Edinburgh University Press).

Marcel, A. (1983), 'Conscious and unconscious perception: Experiments on visual masking and word recognition', *Cognitive Psychology*, **15**, pp. 197-237.

Mauskopf, S.H. and McVaugh, M.R. (1980), *The Elusive Science: Origins of Experimental Psychical Research* (Baltimore: Johns Hopkins University Press).

McGinn, C. (1991), *The Problem of Consciousness* (Oxford: Blackwell).

McGinnies, E. (1949), 'Emotionality and perceptual defense', *Psychological Review*, **56**, pp. 244-251.

Milton, J. and Wiseman, R. (1999), 'Does psi exist? Lack of replication of an anomalous process of information transfer', *Psychological Bulletin*, **125**, pp. 387-391.

Murphy, G. and Ballou, R.O. (ed.1960), *William James on Psychical Research* (New York: Viking Press).

Myers, F.W.H. (1915), *Human Personality and Its Survival of death*, 2 Vols., (New York: Longmans, Green & Co; Originally published in 1903).

Nagel, T. (1974), 'What is it like to be bat?', *Philosophical Review*, **4**, LXXXIII, pp. 435-450.

Natsoulas, T. (1978), 'Consciousness', *American Psychologist*, **33**, pp. 906-914.

Natsoulas, T. (1983a), 'Addendum to "consciousness", *American Psychologist*, **38**, pp. 121-122.

Natsoulas, T. (1983b), 'Concepts of consciousness', *Journal of Mind and Behaviour*, **4**(1), pp. 13-59.

Nelson, J. (1978), 'Detecting small amounts of information in memory: Savings for nonrecognized items', *Journal of Experimental Psychology: Human Learning & Memory*, **4**, pp. 453-468.

Nelson, N., Dunne, D.J., and Jahn, R.G(1984), *An REG Experiment with Large Data Base Capability.3: Operator Related Anomalies* (Technical Note PEAR 83002), (School of Engineering/Applied Science: Princeton University).

Newsweek Poll (1994). *Newsweek Survey, Search for the Sacred*, Nov. 3-4

Palmer, J. (1971), 'Scoring in ESP tests as a function of belief in ESP Part 1. The sheep-goat effect', *Journal of the Society for Psychical Research*, **65**, pp. 373-408.

Palmer, J. (1979), 'A community mail survey of psychic experiences', *Journal of the American Society for Psychical Research*, **73**, pp. 221-251.

Palmer, J. (2003), 'ESP in the ganzfeld: Analysis of a debate'. In *Psi Wars: Getting to Grips with the Paranormal*, eds. J. Alcock, J. Burns and A. Freeman (VA, Imprint Academic).

Palmer, J. & Carpenter, J.C. (1998),'Comments on the extraversion-ESP meta-analysis by Honorton, Ferrari and Bem', *Journal of Parapsychology*, **62**, pp. 277-282.

Parapsychological Association (1989), 'Terms and methods in parapsychological research', *Journal of Humanistic Psychology*, **29**, pp. 394-399.

Persinger, M.A. (1985), 'Subjective telepathic experiences, geomagnetic activity and the ELF hypothesis: Part II. Stimulus features and neural detection, *Psi Research*, **4**(2), pp. 4-23.

Persinger, M.A. (1989), ' Psi phenomena and temporal lobe activity: The geomagnetic factor'. In *Research in Parapsychology*, eds. Henkel and R.E. Berger, 1988 (Metuchen, NJ: Scarecrow Press).

Persinger, M.A. and Krippner, S. (1989), 'Dream ESP experiments and geomagnetic activity', *Journal of the American Society for Psychical Research,* **83**, pp. 101-116.

Poetzl, O. (1917), 'The relationship between experimentally induced dream images and indirect vision', *Psychological Issues,* **2**, pp. 41-120.

Putman, H. (1991), 'The nature of mental states'. In *The Nature of Mind,* eds. D.M Rosenthal (New York: Oxford University Press).

Radin, D. I. (1999), *The Conscious Universe* (San Franscico: Harper Edge).

Radin, D.I., May.E.C. and Thomson , M.J. (1985), 'Psi experiments with random number generators: Meta-analysis', Part-I. In *Research in Parapsychology,* eds. D.H. Weiner and D.I. Radin (Methuchen, NJ: Scarecrow Press).

Rao, K.R. (1966), *Experimental Parapsychology: A Review and Interpretation,* (Springfield, IL: Charles C Thomas).

Rao, K.R. (1977), 'On the nature of psi', *Journal of Parapsychology,* **41**, pp. 294-351.

Rao, K.R. (1982), 'J.B. Rhine and his critics'. In *J.B. Rhine: On the Frontiers of Science,* ed. K.R. Rao (Jefferson, NC: McFarland & Co).

Rao, K.R. (2005), 'Perception, cognition and consciousness in classical Hindu psychology', *Journal of Consciousness Studies,* **12**(3), pp.3-30.

Rao, K.R. and Palmer, J. (1987), 'The anomaly called psi: Recent research and criticism', *Behavioral and Brain Sciences,* **10,** pp. 539-51.

Rao, K.R., Dukhan, H. and Rao, P.V.K. (1978), 'Yogic meditation and psi scoring in forced-choice and free-response tests', *Journal of Indian Psychology,* **1**, pp.160-175.

Rao, P.V.K. and Rao, K.R. (1982), 'Two studies if ESP and subliminal perception', *Journal of Parapsychology,* **18**, 165-177.

Rhine, J. B. (1934), *Extra-Sensory Perception* (Boston: Boston Society for Psychic Research).

Rhine, J.B. and Pratt, J.G. (1954), 'A review of the Pearce-Pratt distance series of ESP tests', *Journal of Parapsychology,* **18**, pp.265-177.

Rhine, L.E. (1961), *Hidden Channels of the Mind,* (New York: Morrow).

Rhine, L.E. (1965), 'Toward understanding psi-missing', *Journal of Parapsychology,* **23**, pp. 259-274.

Roll, W.G. (1966), 'ESP and memory', *International Journal of Neuropsychiatry,* **2**, pp. 505-521.

Roll, W.G. (1987), 'Memory and long body', *Theta,* **15**, pp. 10-29.

Sargent, C.L. (1981), 'Extraversion and performance in "extra-sensory perception" tasks', *Personality and Individual Differences,* **2**, pp. 137-143.

Schacter, D.L. (1985), 'Priming of old and new knowledge in amnesic patients and normal subjects', *Annals of New York Academy of Sciences,* **444**, pp. 41-53.

Schacter, D.L. (1989), 'On the relation between memory and consciousness: Dissociable interaction and conscious experience'. In *Varieties of Memory and Consciousness: Essays in Honor of Endel Tulvin,* eds. L. Roediger and F.I.M. Craik (Hillside, NJ: Erlbaum).

Schechter, E.I. (1984), 'Hypnotic induction vs. control conditions: Illustrating an approach to the evaluation of replicability in parapsychological data', *Journal of the American Society for Psychical Research,* **78**, pp. 1-27.

Schmeidler, G.R. (1971), 'Respice, adspice, prospice', *Proceedings of Parapsychological Association,* **8**, pp. 117-143.

Schmeidler, G.R. (1991), 'Perceptual processing of psi: A model', *Journal of the American Society for Psychical Research,* **85**, pp. 217-236.

Schmidt, H. (1969), 'Precognition of quantum process', *Journal of Parapsychology,* **33**, pp. 99-108.

Schmidt, H. (1975), 'Toward a mathematical theory of psi', *Journal of the American Society for Psychical Research,* **69**, 301-319.

Schmidt, H. (1984), 'Comparison of a teleological model with quantum collapse models of psi', *Journal of Parapsychology,* **48**, pp. 261-276.

Scriven, M. (1962), 'The frontiers of psychology: Psychoanalysis and parapsychology'. In *Frontiers of Science and Philosophy,* ed. R.G. Colodny (Pittsburgh, PA: University of Pittsburgh Press).

Searle, J.R. (1992), *The Rediscovery of the Mind* (Cambridge, MA: MIT Press).

Shoemaker, S. and Swinburne, R. (1984), *Personal Identity* (Oxford: Blackwell).

Sutherland, S. (1989), *The International Dictionary of Psychology* (New York: Continuum).

Spencer-Brown, G. (1953), *Probability and Scientific Inference* (New York: Longmans, Green).

Stevenson, I. (1987), *Children Who Remember Previous Lives: A Question of Reincarnation,* (Charlottesville, VA: University Press of Virginia).

Stokes, D.M. (1997), *The Nature of the Mind: Parapsychology and the Role of Consciousness in the Physical World* (Jefferson: NC: McFarland).

Stout, G.F. (1899), *A Manual of Psychology* (New York: Hinds, Noble, & Eldredge).

Tart, C.T. (1963), 'Possible physiological correlates of psi cognition,' *International Journal of Parapsychology*, **5**, pp. 375-386.

Thouless, R.H. and Wiesner, B.P. (1948), 'The psi process in normal and "paranormal" psychology', *Proceedings of the Society for Psychical Research*, **48**, pp. 177-196.

Titchner, E.B. (1915), *A Beginner's Psychology* (New York: MacMillan).

Tyrrell, G.N.M. (1947), 'The modus operandi of paranormal cognition', *Proceedings of the Society for Psychical Research*, **48**, pp. 65-120.

Vasiliev, L.L. (1976), *Experiments in Distant Influence*, (New York: Dutton; Originally published in 1963).

Volpe. B.T., Le Doux, and Gazzaniga, M.S. (1979), 'Information processing of visual stimuli in an "extinguished" field, *Nature*, **282**, pp. 722-724.

Varvoglis, M. and McCarthy, D. (1986), 'Conscious-purposive focus and PK: RNG activity in relation to awareness, task-orientation, and feedback'. *Journal of the American Society for Psychical Research*, **80**, pp. 1-30.

Walker, (1975), 'Foundations of paraphysical and parapsychological phenomena'. In *Quantum Physics and Parapsychology* eds. Oteri, L. (New York: Parapsychology Foundation).

Weinberger, J., Kelner, S., and McClelland, D.C. (1990), 'The effects of subliminal symbiotic stimulation on free-response and self-report mood', unpublished manuscript (Garden City, NY: Derner Institute, Adelphi University).

Weiskrantz, L. (1986), *Blindsight: A Case Study and Implications* (Oxford: Oxford University Press).

Weiskrantz, L. (1988), 'Some contributions of neuropsychology of vision and memory to the problems of consciousness'. In *Consciousness in Contemporary Science*, eds. A.J. Marcel and E. Bisiach (Oxford: Oxford University Press).

Wiseman, R. and Schlitz. M. (1997), 'Experimenter effects and the remote detection of staring', *Journal of Parapsychology*, **61**(3), pp. 197-207.

The Theory of Rasa as expounded in Indian Aesthetics, Poetics and Dramaturgy

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"rasō vai sah rasam hyēvāyam labdhvānandī bhavati"

" yogānandaparāh kēcidbhōgānandaparāh parē
vayam sarvapradātāram rasānandamupāsmahē "

Rasa, the essence of art experience is not a product of mundane logic for, any logic is cognitive in nature and is nothing more than an information. But experience, especially that of art is contemplative in nature and hence remains untranslatable.

The realization of *Rasa* happens through the synthesis of *vibhāva* (stimulus), *anubhāva* (responses) and *vyabhicāribhāvas* (transitory emotions). This has been codified by Bharata in the sutra: *'vibhāvānubhāvavyabhicārisamyōgād-rasanispattih'*. Accordingly, this synthesis sublimates the *sthāyibhāva* (latent emotion) to the level of *Rasa* - pure enjoyment, devoid of desire - *akāmahata.*

Bhāvas or the emotions are termed as cittavrttis, attitudes of our mind. According to *Nātyasāstra*, there are eight *sthāyibhāvas* and thirty-three *vyabhicāribhāvas.* The former are permanent while the latter are transient. Their number may be debatable. But their existence and implications are truly indisputable. Bharata also speaks of eight *sāttvikabhāvas* (involuntary psycho-mental responses) which can be effectively used in acting, dancing and poetic descriptions. They can also be roughly enlisted under the heading of *anubhāvas.*

As mentioned earlier, art is metalogical. Hence, here the theory of causation and its physical or mundane sense is practically useless. Thus the equations of cause and effect, *kārana* and *kārya* give way to *vibhāva* and *anubhāva* respectively. *Vibhāva* can be two-fold viz, *ālambana* (supporting) and *uddīpana* (encouraging). The synthesis of all these emotions leading to the sublimation of the *sthāyin* reveals the *Rasa*. However, the words *samyoga* and *nispatti* in the *Rasasūtra* have given ways to many interpretations based on the governing philosophies behind them. Unfortunately, not all these theories are available in their original format. Only the interpretation of Abhinavagupta, in his magnum opus *Abhinavabhārati* has summed up[1] some of the most striking interpretations propounded by people like Lollata, Samyukta and Bhattanāyaka. However, some of the later writers like Bhōja, Rāmacandra-Gunacandra, Jagannātha, etc have given their own interpretations in their treatises on aesthetics/poetics.

According to Lollata, who is highly influenced by the Vaiśesika or Mīmāmsā schools of philosophies, *nispatti* means *utpatti* itself, i.e, *Rasa* is created. Acording to him, the word *samyōga* in *Rasasūtra* means *janya-janakabhāva* and *pōsya-pōsakabhāva* with respect to the *sthāyi* and *vibhāva* and *sthāyi* and *vyabhicāris* respectively. But this theory fails to explain the relationship between the art and the connoisseur, actor and the character, etc. However, by saying that the *'Rasa'* is in the work of art itself, Lollata has indirectly emphasised a great deal on the structure of art alongwith its substance. However, the process of realization of *Rasa*, as an experience through art is left unexplained in this theory. Hence *Rasa* has become a mere objective and thus a quantified entity like other things in the mundane world.

Samkuka, interpreting the *Rasasūtra* from the philosophical standpoint of Nyāya school opines that *Rasa* is inferred by the connoisseur. According to him, *nispatti* means *anumiti* or inference. He tries to see the relationship of *gamya-gamakabhāva* between *Rasa* and the *vibhāvānubhāvavyabhicāris*. Even the word *samyōga*, according to him, means the same. Thus *Rasa* is no more than *pratīti* or information or understanding at the most and not *anubhava*, experience. But if it were to be the reality, art experience would have led us towards *rāga* or *dvēsa* leading to *sukha* or *duhkah* in the worldly sense and not *ananda*, selfless contemplative joy which is essentially non-materialistic. In Samkuka, art experience has become nothing more than an intellectual exercise. Added to this, the interpretation of Samkuka forces all *bhāvas* aiding art experience to become either personally connected (*svagata*) or not (*paragata*). In both the cases, the resulting feeling will be either abnormal or subnormal, for *svagata* leads to *sukha-duhkah* and *paragata* to *audāsīnya.*

However, the analogy of 'citraturaga' adopted by Samkuka makes us realize the element of 'willing suspension of disbelief' in art and his explanation of *āhāryajnāna*, knowledge by supposition or superimposition in the realm of art has opened greater vistas to reveal the secret of art experience and solve the riddle of *Rasa*. But the unconnectedness of the art-artist and the connoisseur remained as it is. Even then, the emphasis on inference (*anumiti*) influenced the actors to imitate well and the artists to paint or carve well the objects of reality. Hence, there is an element of realistic leanings in this interpretation.

Bhattanāyaka, supposed to have been influenced by Sāmkhya and *Yōga* alongwith the canons of Pūrvamīmāmsā philosophies, invariably inspired by the theories of dhvani or suggestion in art in a negative way, propounded his interpretation of *Rasasūtra*. At the place of *vyanjanā*, the way of suggestion, an invariable way to realize *Rasa*, he proposed the concept of *bhāvakatva* (appreciation) and *bhōjakata* (enjoyment). These are mostly inspired by the theory of *bhāvanā* of Mīmāmsā. Accordingly, the concept of *bhāvakatva* excludes an art-piece from all the biases of space and time. Thus the art being cultured to a level of impersonality becomes enjoyable due to its nature of *bhōjakatva*. In other words, the *rajas* and *tamas* in the content of art are purified to the level of *sattva* due to its structured uniqueness and thus enriched sattva will become exceedingly relishable to the *sahrdayas* (connoisseurs). This idea of *bhōjakatva* is naturally influenced by the philosophy of Sāmkhya, well-known for its *gunatraya* theory.

However, Bhattanāyaka's interpretation falls short of some very valid requirements for, *Rasa* is not just a thing of enjoyment, that itself is enjoyment (*na kēvalamāsvādyatē rasah svayamāsvāda ēva*). And also the superfluous dual concepts of *bhāvakatva* and *bhojakatva* are not essential for they can be well replaced by the one concept of *vyanjanāvāda*. Above all, his theory does not raise *Rasa* beyond its relative level of plurality. Apart from this, Bhattanāyaka has not solved the problem of whose *sthāyibhāva* is going to be sublimated. Inspite of all these wanting things, Bhattanāyaka's theory finds a very high place in the history of *Rasa* theory due to his contributions such as *sādhāranīkarana* (universalization), *sattvōdrēka* (enriched consciousness), *cittavisrānti* (tranquilling the mind), etc.

Now we may proceed to the interpretation of *Rasasūtra* in the light of Abhinavagupta and his followers. This is essentially based on the Upanisadic philosophy, especially according to the Advaitic understanding. Accordingly, art experience is very unique for the various types of realities (*sattās*) such as *prātibhāsika*, the seeming, *pāramārthika*, the absolute and *vyāvahārika*, the mundane are unable to explain its exact nature. It is only the *āhāryasatta*, the reality of embelishment makes a convincing attempt in this regard. Thus, art experience becomes a meeting point of temporal and spiritual realities. Here though, the clutches of inherent ignorance, avidyā is not wiped off, its sequential products such as *adhyāsa* (superimposition), *kāma* (desire), *karma* (involved activity), etc. are all astonishingly avoided and thus a great deal of spiritual and hence obviously transcendental experience is attained.

In the mundane world, almost all activities end up either in profit or in loss. Thus they impart pleasure or pain in our hearts. But in art experience it is not so. Likewise, every object in the material world triggers either desire or reluctance in our mind. But in art experience neither of these reactions are felt. However, there continues a sustained disinterested belongingness or compassion - a selfless appreciation. That is why painted fruits do not kindle hunger or dismay in the hearts of an ideal art-lover, however hungry he may be.

All the activities of the materialistic world are driven by the forces of rajas and tamas. Hence pain or pleasure, hatred or fear, attraction or repulsion are the products of these forces. When the very desire, the root of all propositions and dispositions is not evoked, naturally its products like selfish activity, pain, pleasure, fear, hatred, etc are all completely avoided. Thus pure consciousness or *śuddasattva* reigns supreme, however temporary it may be. This is the secret behind our enjoyment of a tragedy, appreciation of a beautiful painting or sculpture choosing 'ugliness' as its subject, appreciation of a villain or a vamp in a novel or play.

This sort of 'involving without involvement' or appreciation independent of materialistic beauty or ugliness, ethical or unethical practices is essentially due to a selfless-universal-contemplative concern or involvement. It can be compared very well with the concept of *Jīvanmukta* of Vēdānta who likewise enjoys the world around him itself as a divine art, divine comedy! But a liberated soul like a *Jīvanmukta* independent of any external stimulus lives in bliss forever unlike a true art-lover who should always depend on such an agency. As long as the art-piece, that which contains the ideal synthesis of *vibhāvānubhāvasāmagri*, the emotional cocktail is under the purview of the said connoisseur, he will be in the state of bliss or *rasānanda*. Once this arrangement disappears, he is left for himself in the mundane world. Therefore, unlike the worldly relationships of the order of *jnāpya-jnāpaka* or of *kārya-kāraka*, the relationship of the *vyangy-vyanjaka* pattern is seen in the art experience with respect to *vibhāvānubhāvas* and *Rasa*. Here lies the secret of the metaworldly nature *(alaukikatva)* of *Rasa*. Such a nature of *Rasa* cannot be established externally using the techniques of either direct perception or inference. But this is not a failure for, the art-experience is truly felt and thus needs no more 'proofs'. Thus, in total, *rasānanda* is just one step below *brahmānanda*, or rather it is *brahmāsvāda sahōdara*. Here, enjoyment and awareness, i.e, *prīti* and *vyutpatti* (joy and wisdom) are no two things. They become one with our existence. Such *Rasa* is never realized through the art-pieces directly. It is always experienced through a trigger of oblique expression *vakrōkti* and the process of realization is through the way of suggestion. The threefold nature of meaning associable with any expression, viz, *abhidhā*, the designated, *laksanā*, the implied and *vyanjanā*, the suggested have their supreme reigning in the logical, colloquial and aesthetic worlds respectively. However, acceptance of a suggested meaning is always contexted by the culture which has produced the art-piece and the art-lover. Such a cultural contextualization is termed as *aucitya*, propriety. Hence, *vakratā, dhvani, aucitya* and *rasa* become the key terms in art experience or aesthetics.

To conclude, art experience is essentially idealistic, i.e, spiritual. However, in India, both the realistic and the idealistic schools of philosophies tried to explain the riddle of *Rasa*. To sum up, in the words of Prof. M. Hiriyanna: "The aim of art according to both the systems, is to induce a mood of detachment. But according to idealistic *Vēdānta*, the artistic attitude is characterised by a forgetting, though temporary of our individuality; while according to realistic *Sāmkhya*, it is due to an escape from the natural world. According to the former, art serves as a pathway to reality; but according to the latter, it is so to speak a deflection from reality. The one reveals the best in nature, while the other fashions something better than nature." (Hiriyanna, 1978)[2].

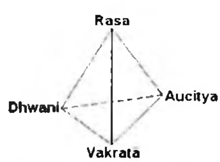
Appendix

Here are two graphical representations attempting at a simpler way of understanding the relationship between a few major key-terms in *Rasa*-synthesis and even the process of the same. However, these graphical representations of mine are only analogous models and hence may not cover all the intricate features associated with the complex theory of *Rasa*.

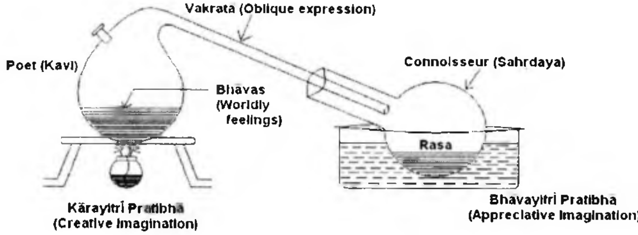
References

[1] Even Mammata in *Kāvyaprakāśa* has done such summing up.

[2] Hiriyanna, M. (1978), "Art Experience" (Mysore: Kavyalaya Publishers) pp 15-16.



AESTHETIC TETRAHEDRON



AESTHETIC DISTILLATION

The "Conscious" Bacterium

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Microorganisms are commonly perceived primarily as the causative agents of most contagious diseases that plague the humankind. This view gradually changed during the first half of the twentieth century, whereby, they began to be recognized as model organisms to study fundamental aspects of life processes, giving birth to a new field called molecular biology. Recent studies have shown that bacteria are extraordinarily perceptive to their surroundings and can respond to changes in the most amazing ways. They can communicate with others and can collaborate as a group to mount elaborate behavioural responses to environmental challenges. The article aims to examine some of these recent findings in the context of cognition studies on "higher" organism. The major goal is to highlight the possibility that a rudimentary form of "consciousness" could be encountered in bacteria, forcing us to broaden the way we think about this enigmatic entity.

Introduction

A simple-minded definition of physiological consciousness, devoid of any philosophical or metaphysical implications, is the ability to perceive sensory stimuli and respond by purposeful movement or by a behavioural change. Studies in this area generally come under the broad grouping of cognitive neuroscience, intimately connected with the workings of the brain. This forces one to ask the question - *Can organisms without a 'brain' such as bacteria be conscious?* As they dominated the scene for a substantially long period of time since life arose on this planet (multi-cellular creatures evolved much more recently), is it possible that a rudimentary form of consciousness is lurking within them? It will not be very surprising if it did, as bacteria have their own version of complex signaling systems and genes that regulate cell shape, growth and development that are in a sense the forerunners of the eukaryotic counterparts. They live in environments as varied as hydrothermal vents at substantial depths below the ocean surface to polar ice caps. They can detect traces of nutrients in the surroundings and move towards the gradient and similarly move away from low concentrations of repellants. They communicate with each other to coordinate responses such as sporulation to tide over adverse conditions or production of toxins to mount an attack against host defenses, thus optimizing the chances of successful colonization. This article is an attempt to highlight some of these recent findings to an informed but non-specialist reader. Therefore, technical references are avoided as much as possible.

The Rise of Microbiology

The early history of microbiology is closely associated with the discoveries that linked microorganisms and infectious diseases. This period was dominated by stalwarts such as Pasteur, Lister, and Koch. Even today, Koch's postulates form the fundamental basis for testing the causal connection between a pathogen and the disease it is associated with. This was an important period in terms of recognizing some of the critical factors responsible for human health and welfare. Vaccines and other antimicrobial agents became possible because of these discoveries. The shift in the focus on microorganisms as the agents of disease to sources of basic knowledge was a transition that took place during the first half of the twentieth century. Interestingly, early attempts in this direction were prompted by the quest to understand the ability of bacteria to cause disease.

The Birth of Molecular Biology

One of the turning points in the history of science was the discovery of the first genetic link in the pathogenicity of the bacterium *Streptococcus pneumoniae* (commonly known as pneumococcus), the causative agent of pneumonia. In 1928, Griffith, a physician studying pneumococcus, found that the virulent bacterium that normally forms shiny smooth colonies on a Petri dish can occasionally show up as a variant that forms rough colonies. Interestingly, the 'rough' variant is harmless and cannot cause pneumonia in mice whereas the smooth variety is deadly. Even more puzzling was his observation that an extract from the smooth kind is able to "transform" the rough variant to the smooth type simply by mixing with it. In other words, "something" in the extract could bring about a genetic conversion of the rough form to the smooth type. The hunt for the agent that results in the transformation ultimately led Avery and his colleagues MacLeod and McCarty to the chemical basis of the gene, DNA, sixteen years later. This was at a time when the prevailing view was that the bacterium is nothing but a bag of enzymes, with no clear idea that they carry genes. Just a year ago, another microbiologist, Salvador Luria, along with his mentor Max Delbruck, a theoretical physicist, had used the gut bacterium *Escherichia coli* to experimentally demonstrate the Darwinian idea of natural selection. In their now famous experiment, Luria and Delbruck showed that variants of the bacterium that are resistant to the T1 virus preexist in the population and are selected when challenged with the virus. The discovery of sex in bacteria by Lederberg around the same time was a shot in the arm for bacterial genetics, an oxymoron only a few years ago. The double helical structure of DNA and the deciphering of the genetic code were soon to follow. Molecular biology, a new discipline prompted by the quest for the molecular basis of heredity, was born in the mid twentieth century, primarily using *E. coli* as the workhorse. The bacterium as a model organism to investigate the fundamental properties of life had come to stay.

A Bacterial Paradigm for Gene Regulation

As the molecular basis of heredity was being uncovered, one of the fundamental questions to be addressed was how genes can be switched on and off, a feature essential for the integrity of the cell. The answers came with the striking discovery by Jacob and Monod that bacteria can turn on and turn off genes at will, depending on the requirement. Their studies focused on the breakdown of the milk sugar lactose by *E. coli*. The dramatic results that they came up with showed that *the genetic information for making the enzymes to breakdown lactose is accessed only when lactose is present in the medium.* Their model for the first time proposed a molecular lock for the gene, with the key being provided by the substrate. The "operon" model of Jacob and Monod became a paradigm for gene regulation in *all* organisms, resonant with Monod's famous line, "What is true for *E. coli* is true for the elephant". The most significant feature of the model was that the bacterium can *exercise a choice* to express any of its genes. The ability to sense the presence of the substrate and respond by inducing the appropriate enzymes is a tremendous evolutionary advantage in terms of cellular economy.

An Example of Bacterial "Memory"

Parallel to the studies of Jacob and Monod, Novick and Wiener showed that *E. coli* can "remember" its metabolic history. Two independent cultures of *E. coli* were grown, one having a high level of inducer and another with no inducer. When the two were mixed and grown in a medium that had only a low maintenance level of inducer, half the cells in the mixture showed induction, whereas the other half showed no induction. Thus, the epigenetic states of the two cultures could be maintained indefinitely as long as the medium had only a maintenance level of inducer, the "memory" of the cell's metabolic history being transmitted to successive generations.

Bacterial Chemotaxis

Bacteria move towards chemicals that are attractants (for example glucose) and move away from chemicals that are repellants (such as phenol). This is brought about by altering the frequency of "tumbling", the process of changing direction rapidly. This involves the coupling of the chemical sensing system with the molecular motor, the mechanical system involved in motion.

Bacteria move primarily making use of flagella, the whip-like structures on the surface of the cell. At the base of the flagellum is the motor made of proteins that enables it to rotate clockwise or counter-clockwise. Uniform rotation of the flagellum results in a smooth swimming motion. A change in the direction of rotation of the flagellum causes a reversal of direction known as tumbling. The sensors that detect attractants or repellants are located on the cell surface. In response to a positive gradient of attractants, the bacterium continues to swim in the direction of the gradient without tumbling. The moment it starts going away from the gradient, the sensors trigger tumbling so that the cell is back towards the maximum concentration of the attractant. The situation is reversed in the case of the repellant, where movement towards increasing concentration of the repellant stimulates tumbling away from it. Bacterial chemotaxis is a fascinating example of discriminatory behaviour at the microscopic level.

Quorum Sensing in Bacteria

Bacteria regulate many of their physiological and behavioural properties based on their numbers, using a sophisticated signaling mechanism known as "quorum sensing" This was first demonstrated in the marine bacterium *Vibrio fischeri* that emits light only when the bacterial numbers cross a threshold. Many other bacterial responses also involve a measure of the population size or quorum. This is achieved by each cell secreting a signaling molecule that can diffuse in and out of the cell and by having receptors that detect the signal. The threshold concentration of the signal molecule is achieved only when the cell number reaches a critical value. In many cases, success of an operation, such as colonization of the host, depends on the strength of the bacterial army. Quorum sensing provides an extraordinarily elegant mechanism to have a headcount.

In the case of the pathogenic bacterium *Enterococcus faecalis*, the quorum sensing system has evolved to a higher degree to measure both bacterial cell numbers as well as to detect the presence of host cells. In this case, the signaling molecule has two interacting components that can dissociate. One of the components has a higher affinity to receptors on the surface of the host cell and binds to it. This results in a higher concentration of the counterpart of the signaling pair, now left without a partner, leading to turning on of the genes involved in colonizing the host. Thus, "the quorum sensing mechanism is used to detect host cells without actually coming in contact with them like the bat using sonar signals and then locates its prey detecting the echo...Although it has long been suspected that the chemical signals used by bacteria to sense members of their own species could also be used to detect other types of cells, this is the first example of quorum-sensing molecules directly detecting target host cells" (Garcin 2004).

Conclusions

Microorganisms live in a fiercely competitive environment where survival or extinction depends on slender adaptive advantages. As the oldest living inhabitants of the planet, it is not surprising that they have evolved survival strategies that allow them to sense and respond to environmental challenges. At a rudimentary level, many of the sensory mechanisms in bacteria are reminiscent of the cognitive mechanisms operational in higher organisms. Therefore, as evident from the results described above, studying bacterial consciousness might provide us insights on cognitive mechanisms that operate in more "complex "organisms such as ourselves.

References

Molecular Genetics, an Introductory Narrative. G Stent and R. Calendar 1978, Freeman and Co., San Francisco

Jacob, F. and Monod, J. 1961 Genetic Regulatory Mechanisms in the Synthesis of Proteins *J. Molecular Biology* 3: 318-356

Novick, A. and Wiener, M. 1957 Enzyme Induction as an All or None Phenomenon

Proc. Natl. Acad. Sci. USA. 43: 553-566

March, J.C. and Bentley, W.E. 2004 Quorum Sensing and Bacterial Cross-talk in Biotechnology *Current Opinion in Biotechnology* 15: 495-502

Garcin, D.A. 2004 Peptide Signals Sense and Destroy Target Cells *Science* 306: 2202-2203

Coburn, P.H. et al 2004 *Enterococcus faecalis* Senses Target Cells and in Response Expresses Cytolysin *Science* 306: 2270-2272

Neurological Narratives: A Humanistic Study of Oliver Sacks' Narrative Medicine

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Introduction

Our birth is a heroic act of pain painting the pleasure of pinching the unborn. By oscillating between these extreme emotions, we enliven a routine yet extraordinary activity of everyday living. However, the last century and the past half-decade has feared a vehement visitor: illness. By illness, I mean something subjective like feelings of malaise or pain. Quite different from something like a disease physiologically rooted in pathogens like viruses or in revealing symptoms like memory loss.

At the onset of illness, citizens turn into patients and normal life is stalled. This break in the grand continuity of life is even more severed if one is gutted by mental illnesses. Something tries to tear down our mental fabric and strike us out of reality so much so that we begin to contemplate upon the inviolable self that has sustained us in health. Among mental illnesses, neurological disorders (affecting the human nervous system extending into the brain) have a special status because unsupported by nervous system, human body is hardly functional. These disorders cut off the crucial supply for human sustenance: self-awareness and thereby, a healthy existence. Yet, at the same time, the same disorders often reorganize and restrengthen the lost self.

Everybody aspires to tell and retell their story or else "a self without a story contracts into the thinness of its personal pronoun." (Polkinghorne, 1988, 72) "I" [the personal pronoun] – through a story – seeks to organize the world, which the Greeks called *Kosmos* [order.] On the odyssey to order life, the patient's story (or its recounting by a neurologist or a psychiatrist) is a deepest attempt to "mend discordance with concordance." (Ricoeur, 1984, 31) Thereby, revitalizing simple stories into impressive narratives. Neurological Narratives nourish human meaning not by dull documentation of medical case-studies but by cutting through the clinical constraints to return to the critical centre of human existence: self.

Maddening History

It has taken at least thousands of years for man to be made the "measure of all things." And, thereby discharge mental disorders from the heavens and safely lodge them in the human mind. From Greeks to the geeks, mental disorders have journeyed along with the development of human consciousness. In its long endless voyage, mental disorders have absorbed emerging thinking and adopted new meanings.

A gifted Greek, also called the father of medicine, Hippocrates (460 BC – 380 BC) had largely *rationalized* illness through his theory of ***humors***. Hippocratic humors are juices or fluids in our body, namely four: blood, choler, phlegm and melancholy. As the medical historian, Roy Porter explains:

Blood was the source of vitality. Choler or bile was the gastric juice, indispensable for digestion. Phlegm, a broad category comprehending all colorless secretions, was a lubricant and coolant…melancholy…[is a] dark liquid…reckoned responsible for darkening of other fluids, as when blood, skins or stools turned blackish. (2002, 38)

For the body to remain healthy, these humors had to strike the right balance. An imbalance or one humor overpowering the other resulted in illness. The fourth humor, melancholy, was largely responsible for the dark temperament that was commonly observed in the mentally ill. What is interesting about Hippocrates' humoral theory is that it is holistic in its approach and moreover, it centered diagnosis around human body, not on any superhuman Greek god or goddess. As with the treatment for the mentally ill, Hippocrates suggested a regulated mild diet and a simple lifestyle limiting achievable desires.

Indian Ayurveda similarly had three humors (*doshas*): *Vata* (air), *Pitta* (fire) and *Kapha* (water.) In their metaphorical sense, *Vata* is air that circulates thoughts in human mind as well it regulates the blood flow. *Pitta*, as fire, helps maintain body heat and metabolism and in turn, the sensory reactions to the outside world. *Kapha*, as water, provides the essential body mechanisms with liquids and thereby restores biological strength. Again, a balance of these humors is critical for human sanity; else, one tends to lose the mental capability of discrimination (*vivekam*.) Madness or *unmada* was a result of humoral imbalance and in this regard, Ayurveda strived to sift through rich inheritance and sought to blend the physical background of medicine with religious thoughts, spiritual life and ideals.

Meanwhile, Greek philosophy was a major impulse behind starting a long-standing battle between reason and unreason. Greek thinkers had a balanced emphasis on reason and they didn't deny the reality of madness manifesting as unreason. Plato thought that some geniuses were consumed by the divine fire of madness. Greek tragedy was one of the earliest art form that tried to make sense of madness. Unreason was dramatized by playwrights like Sophocles and Euripides as a fate of a divided mind. In Euripides' drama, *Orestes*, the mortal protagonist Orestes is ordered by the Greek God of

Medicine, Apollo to kill his mother and he abides by it. His choice: either to listen to an immortal God or listen to his immortal Soul rips Orestes apart and because of a malicious outcome, he collapses into madness. These kinds of heroes were consumed in the cauldron of hubris and ambition to be torn apart and bring madness upon themselves. In fact, tragedy was used as a therapeutic to inform the mortals of their immoral acts and reform their profane existence into a blissful perseverance.

Meanwhile, the Stoic philosophy also stressed on the conquest of avoidable desires (some may lead to chronic madness) as they brought disappointment to the human soul. So, Hippocratic medicine flourished with Greek drama. But, a Roman physician, Galen was primarily responsible to sustain the Hippocratic spirit till Renaissance. Galen dissected the human body and was responsible of reinstalling human mind in the brain rather than in heart as Aristotle thought it out to be.

Though the Christian Church had colored madness in supernatural contours like the Holy Ghost and the devil fighting for the possession of the individual soul, it also embraced the mysticism of some saints as the visitation of the Holy Spirit. There were patron saints like St. Dymphna of Netherlands who was revered as possessing exceptional healing powers and so is St. Christina the Astonishing and St. Teresa of Avila. Above all, one should view the overarching message of love and compassion towards any sufferer as the greatest gift that Christian medicine has given to the world.

In Christian medicine, there is a concept called anastasis, literally meaning resurrection. Among many interpretations of Christ's resurrection, the spiritual meaning points to the fact that a manlike messiah is revivified with Godlike perfection. This act of Christ allows the sufferer to bounce back from his debilitating condition into an entirely new pattern where God in the form of love would envelop the patient with his grace. This doesn't mean that every one should await to contract illness to enjoy God's grace but illness often has the power to reward the sufferer with abundant solitude to resurrect himself into a finer human being.

The Somatic Turn

During the Age of Reason, keeping up with the all-out assault on Aristotle, Hippocratic medicine was abandoned for the machine medicine of the French polymath, Rene Descartes. Human body was depersonalized and extensive research was done on nervous system and its role in governing emotions and motion. The progress of science, managing society through economy and bureaucracy and the spread of literacy and education contributed in privileging rationality. To bring about order in the society was the zeitgeist and any aberration to this was thought to be something that must be quelled. Descartes' separation of body and mind had an important consequence for medicinal approach to mental illness:

> As consciousness was inherently and definitionally rational, insanity, precisely like physical illnesses, must derive from body, or be a consequence of some very precarious connections in the brain. *Safely somatized* in this way, it could no longer be regarded as diabolical in origin or as threatening the integrity or salvation of the immortal soul, and became unambiguously a legitimate object of philosophical and medical inquiry. (Porter, 2002, 58)

This approach found the fault of mental illnesses not in evil passions or humors but in the cognitive capabilities of the patient. So, a patient could be educated and corrected by restoring sanity in his mind.

As the humoral theory was being replaced by mechanical medicine, the "new science refigured the body in mechanical terms which highlighted the solids (organs, nerves, fibers) rather than fluids." (Porter, 2002, 124) So, insanity was specifically spotted as the malfunctioning of some body part. During this period, an English physician, Thomas Willis (1621-1675) dissected the human nervous system and coined the term "neurology." He provided elaborate and exquisite descriptions about the workings in the brain based on the Cartesian and Newtonian mechanistic views of the world. Body became the vantage point from which mental illnesses were spoken about and the nervous system was given unprecedented importance in doing so.

Right into the 17th century, philosophers like John Locke analyzed the mold of human mind through perception of the sense data that it receives. Knowledge arising from sensations is perfected by reflection, thus enabling humans to convert the sense data into ideas like space, time and infinity. Madness of the mind was a consequence of wrong association of ideas, faulty logical processes; this development remolded conceptions of madness in new directions:

The emerging model of madness as a psychological condition pointed to an alternative target for psychiatric inquiry: rather than organs of the body, the doctor had to address the patient's psyche, as evidenced by his behavior. The case history approach this entailed demanded the transformation of the old craft of minding the insane into the pursuit of systematic psychological observation. (Porter, 2002, 129)

Several case studies of patients with detailed observations of their behavior were regularly documented from now on. As this psychological way of reading derangement emerged, intrapersonal dynamics between the doctor and the patient was stressed. And, the best platform for such encounters to prosper was an asylum. The driving force for such an asylum need not be to completely isolate the patients from the society but to secure them from the assaults and stigma of the society. In turn, helping them to reintroduce themselves into the society afresh and saner. The point was to revive the dormant humanity of the mad by working on residual abnormalities to stimulate normal emotions. During 18th century, this unfettering of mind was the liberating vision of Phillipe Pinel of France, Chiarugi of Italy, the Tukes of York Retreat in England.

With a resolute humaneness, these reformers valued above all kindness as the right medicine for regeneration of patients. Old methods like whipping, bloodletting, straight-jacketing, starvation were replaced by innovative regimes of disciplined work and exercise under vigilance but not confined. The asylum became a self-sufficient outpost where patients labored for their needs by farming, etc. Till today, several pioneering ways of treatment like community centers where patients and psychiatrists live together have been evolving. This points to the fact that asylums are not a permanent solution and the only way out to treat the mentally ill; rather, as new illnesses outnumber the known ways of treatment, novel approaches will continue to emerge.

The Psychoanalytic Turn

One such approach in the twentieth century was the talking cure therapy of the founder of psychoanalysis, Sigmund Freud (1856-1939). Freud was an exceptional molder of modern thought in the sense that he was the first to spot the difference between what one says and what one believes. This is a radical dimension of understanding the everyday operation of the human mind as there is an unconscious belief or striving unknown to us. Freud moved beyond the conceptual understanding of the subject as illness and therapy and was more concerned with human salvation. Freud sought the triumph of the irrational and unconscious passions by reason; the liberation of the man from the power of unconscious within the possibilities of man. Though Freud was a neurologist, he quickly abandoned this career to nourish his genius in an innovative discipline altogether: psychoanalysis.

Freud was adept at writing wonderful narratives about his patients like his famous Dora or Wolf-man clinical case-studies. What

Freud did – in the case of Dora – was to analyze hysteria (a psychological or emotional disorder in which a psychological conflict is turned into physical conflict like blindness) by encouraging patients to freely talk and elicit as many psychological incidents as possible to associate them with the roots of the current conflict. In fact, Freud established:

...a logical continuity in the mental life of the individual, and therefore symptoms were not mysterious incursions from without but rather exaggerated expressions of processes common to everyone which revealed the specific stresses of the patients.(Brown, 1985, 3)

Freud was fervently devoted to extract the aim of mental phenomena whereas psychiatrists were eagerly searching for general principles by which to treat the patient. Simply put, Freud's model was based on the idea that our basic drives are covert, lurking in our unconscious and suppressed by layers of social rules and expectations of civilization. But, as one prominent psychiatrist points out:

Nobody in any society lives his life by rationally planning every single act of emotion, since normal, as well as abnormal, goals are largely unconsciously determined and the essence of normality is that his unconscious goals and conscious aims should be in harmony with each other and appropriate to the situations in which he finds himself. (Brown, 1985, 10)

This idea of the cultural impact upon the mental mould of a person was taken up by neo-Freudians like Karen Horney, Henry Stack Sullivan and above all, most brilliantly by Erich Fromm. A sociologist and psychologist, Erich Fromm (1900-1980) based his theory of individual not on the satisfaction of biological drives (as Freud did) but on the relatedness of the individual to the world. Fromm assesses the extent to which psychoanalysis was successful:

..while psychoanalysis has tremendously increased our knowledge of man, it has not increased our knowledge of how man ought to live and what he ought to do. (1966, 16)

Fromm's cultural approach to psychoanalysis seeks to remedy the above drawback. This approach contends that human nature should not only be explained rationally and biologically but also sociologically as individuals are a cultural product of their environment and zeitgeist. This idea is echoed in a neuroscientific phenomenon called ontogenesis – the development of an individual as an exquisite interplay between genes and the environment. For Fromm, man in interacting with the environment, not only changes it but also changes himself in the process: develop his potential and transform it in sync with his possibilities. But:

Man's evolution is based on the fact that he has lost his original home, nature – and that he can never return to it...there is only one way he can take: to emerge fully from his natural home, to find a new home – one which he creates, by making the world a human one and becoming truly human himself. (Fromm, 1968a, 25)

Squeezed between regression and progression, man has to make a choice that will either aid in his psychological growth or reduce him only with his physiological growth. If Freud had rooted the motivating energy behind human passions and desires in libido, Fromm roots the impulse in the human situation itself common to all human existence. Every individual wants to realise his potential whereas society frustrates and binds him. So, a society's prevalent structure and ethos largely determine the idea of the conscious and unconscious. Fromm points out that:

Consciousness represents social man, the accidental limitations set by historical situation into which the individual is thrown. Unconsciousness represents universal man, the whole man, rooted in the Cosmos; it represents [everything everywhere and] his past down to the dawn of human existence, and it represents the future to when day when man will have become fully human. (1986, 58)

We are powerful enough to be aware of our existence but at the same time are faced with utter powerlessness and usurping limitations. Fromm resolves this paradoxical situation in the wellspring of wellbeing.

All Shall be Well

Our wellbeing is influenced by intricate and subtle psychological principles that build and guide our self-understanding. For Fromm, a healthy existence doesn't just lie in physiological fitness but in psychological wellness whereby an individual develops totally and to the best of his capabilities of mind.

When once cannot face his frailty and make himself fragile with a façade of illusions about himself that others tell him and he himself imagines, he begins to taste the recipe of despair. And no one has extensively studied the roots of despair as Søren Kierkegaard, who according to Nathan Scott Jr. has studied the human situation animated by:

...despair [which] is the sickness unto death precisely because it is that illness of the spirit which is the consequence of a man's flight from the reality of his own selfhood. (1978, 44)

There is a pervasive unavoidable sense of suffering in everyone's life. One has to accept the way he is first and has to acknowledge that existence is the gradual triumph over suffering. Either we thirst for a glorious Edenic past and remain underdeveloped or we absorb ourselves in the humdrum of the present so much that we deliberately disconnect ourselves from the real world and the human reality. Fromm strikes at the root of our very existence:

> Birth is not one act; it is a process. The aim of life is to be fully born, though its tragedy is that most of us die before we are thus born. To live is to be born every moment. (1986, 31)

In the process of living, we acquire a wealth of knowledge about ourselves. Through this self-knowledge, we take hold of the liberating forces of spontaneous growth. Using these forces, we have to gradually loose the neurotic obsession with ourselves and develop love and concern for others. In developing a healthy friction with the wishes and wills of others, one is regularly challenged by choice-making: in this situation, should I preserve myself or surrender myself to a greater self of others? One may choose to submit oneself to an overarching Other like God, but the prudence of this choice can be understood in the light of Kierkegaard's interpretation of the story of Abraham's sacrifice of his son, Isaac in the Old Testament.

The Jewish patriarch, Abraham, in spite of an ethical obligation to preserve his son's life, obeyed the word of God as he was torn between the love towards his son and love of the God while sacrificing his son. This doesn't imply that Kierkegaard wants us to give in to universal norms but he takes the story further by inferring that only:

> ...when a man has really submitted himself to the universal norm and found it insufficiently comprehensive of *his* reality, he must then – and *only* then- dare to transcend it, dare to declare himself an exception: namely, one the concreteness of whose individual life is not fully reckoned with by a universal norm. (Scott Jr, 1978, 41)

The courage to make such a crucial decision is called "faith." It is:

> ...a matter of the courage with which man, in the most critical situations of his life...dares to take a stand *in behalf of his own humanity*, choosing that which promises most deeply to validate what he has found to be the essence of his manhood. (Scott Jr, 1978, 41)

So, one has to consistently make priceless or worthless decisions in life and their consequence is determined by the faith with which one takes them. One such profound faithful decision is taken by Fromm to decide what well-being is:

Well-being means to be fully related to man and nature affectively, to overcome separateness and alienation, to arrive at the experience of oneness with all that exists - and yet to experience myself at the same time as the separate entity *I* am, as the in-dividual. (1986, 36)

Nowadays, patients function well socially without any illness; but, they suffer from the malaise of inner deadness. Without knowing what they suffer from, they make various complaints which are only the conscious form in which our culture permits them to express something. These symptoms become obsessive once they enter everyday business of life. This common suffering is the alienation from oneself, from one's fellow human and from nature. For those who suffer from alienation, "cure doesn't consist in absence of illness but in presence of well-being." (Fromm, 1986, 28)

The Need for Narrative

Narratives amaze, console and make the reader filter meaning out of quotidian existence. Narratives enfold the human self in cognitive activities bigger as well as other than itself. Is the real world already organized into a narrative or we transform reality into a narrative? Every narrative aims to tidy reality through various techniques involving time, sequence and order of storytelling.

Factual narratives enjoy an alliance with reality – however distorted it may be. Medical narratives first preserve the anonymity of the patient and thereby, rename them into fictitious characters. Through a felt (essentially phenomenological) experience, narrators excel at recording these experiences. By just telling stories, we make sufferers as bland human subjects. They not only succumb to the disease but are consumed by it. A patient's *inviolable* self narrows down to a diseased or drugged self. So, a master storyteller transforms soulless case-histories into soulful narratives. In the process, the patient becomes the protagonist so that "we have a 'who' as well as a 'what', a real person, a patient, in relation to disease – in relation to the physical." (Sacks, 1985, xiv) To talk about illnesses is quite different from writing about illnesses. As Hayden White explains:

> Narrative might well be considered a solution to a problem of general human concern, namely, the problem of how to translate *knowing* into *telling*, the problem of fashioning human experience into a form assimilable to structures of meaning that are generally human rather than culture-specific. (1980, 5)

Neurological narratives are telling ways of moving across and beyond cultures to create shared realities which enhance and endorse human experience. Neurological narratives excel at the prescription of Paul Ricoeur that narrative conclusions "rather than being predictable ...must be acceptable." (Ricoeur, 1980, 174)

Because these narratives always don't have a happy end, there are quite unpredictable yet most of them leave us at various levels of acceptability. This suggests that while treating disorders, we may not anticipate complete amelioration but rather hope that the treatment acquires a teleological strength as time passes by. So, narrative time coincides with the time taken to better the patient's condition.

The overriding theme of Sacks' neurological narratives is the loss or excess of a critical role of a specific portion of the brain and the events that emerge out of such circumstances and how a neurologist diagnoses and elucidates the problem and decides the course of treatment. These narratives cover copious aspects of human life tinting it with the various contours.

Starving for the Self: the Existential Turn

Everyone has an inviolable innermost centre from which we participate in life: self. Most identify this centre as brain but in fact, our self is an indescribable ever-accumulating essence of existence. One of the most incisive approaches towards the study of self has been done by existentialists. To exist is not that one *is* but to be and become what one is potentially capable of and stand out in the world not only in uniqueness but also in oneness.

Existentialism has been a major philosophical movement that has richly contributed about the limited freedom and unlimited possibilities of human life. Through its meticulous analysis about the human situation, existentialism has sustained a scrupulous "style of philosophizing." (Macquarrie, 1978, 14) With existence peculiarly possible to man, existentialism places man at the centre and studies his situation from various foci like his "quest of authentic selfhood," (ibid, 17) strong emotional life.

For existentialists, being is what envelops the whole of cosmos and to delve into the meaning of being, man is specially qualified. Endowed with openness and freedom, man can inquire into who he is in particular and the meaning of being in general. The gravest threat to being is nonbeing that generally manifests in the form of death. Though death is extensively dealt by existentialists, they are not limited by any fixation with death. They acknowledge that being can only be savored in a context permitting an awareness of the ever-present possibility of nonbeing or death. Once the realization about this finitude dawns on oneself, each moment becomes more precious and one takes stock of one's own life.

Everyone is enlivened by an ambition to move ahead in life and actualize a possibility. For the Danish philosopher Søren Kierkegaard, freedom is possibility, which is animated by our decisions and choices and the impossibility of evading the outcomes.

For possibilities to be actualized, we require to plod through "an intermediate determinant [called] anxiety." {1976, 128}

One comes to realize that there is a point at which they might cease to be and their encounter with reality becomes characterized by anxiety:

> Anxiety is the awareness of unsolved conflicts between structural elements of the personality, as for instance conflicts between unconscious drives and repressive norms, between different drives trying to dominate the centre of the personality...between the will to be and the seemingly intolerable burden which evokes the open or hidden desire not to be. (Tillich, 1977, 64)

According to the existential theologian, Paul Tillich, there are two types of anxiety: existential and pathological. Existential anxiety is embedded in our existence as we are constantly threatened by nonbeing or death. In the face of meaninglessness or death, everyone is existentially *empowered* with this basic anxiety. To reject it is a fatal mistake; one has to live with it as it cannot be removed.

If one evades existential anxiety by running away from it or refuting its continuation in one's life, then pathological anxiety erupts. For Tillich, pathological anxiety is "a state of existential anxiety under special conditions." (ibid, 65) What these conditions are depends upon how one tackles nonbeing. One of the principle ways of dealing with anxiety is courage which emerges from an *in-spite-of* challenge: the self triumphs over that which prevents it from *affirming* itself. This self-affirmation is the first step towards contracting with courage. Courage helps us to deal with anxiety as it "resists despair by taking anxiety into itself." (ibid, 66)

If one fails to confront anxiety and avoid it, then one disintegrates into neurosis. Tillich applies the term neurosis generally to "the way of avoiding nonbeing by avoiding being." (ibid, 66) One may have a fervid sense of self-affirmation but on a limited scale where the self erects a strong defense against actualization of the numerous potentialities. Simply, the self "surrenders a part of [its] potentialities in order to save what is left." (ibid, 66) So, pathological anxiety makes one intensely obsessed about the power of nonbeing.

Neither can one be bogged down by anxiety nor should one by gripped by the threat of nonbeing. Incompleteness of the realizable possibilities in life may evoke a sense of guilt but out of this acceptance, there emerges not despair but a hopeful entry into the realm of promising possibilities. Though the dividing line between sanity and insanity is thin, one needn't give overabundant relevance and emphasis to either. In admitting the inevitability of anxiety, one has to cut through this threat towards an ever-possible actualization of the self.

The eminent neurologist, Oliver Sacks, has an abiding existential undercurrent in doing medicine:

Complementary to any purely medicinal, or medical, approach there must also be an existential approach: in particular, a sensitive understanding of action, art and play as being in essence healthy and free and this antagonistic to crude drives and impulsions. (1985, 91)

The Neuroanthropology of Oliver Sacks

Nowadays, where anxiety has been reduced to physical illnesses, neurology has been nourished by narratives that bring alive these anxieties with limited yet extraordinarily effects. Among the pantheon of prominent neurologists of the twentieth century, Oliver Sacks stands out because of two main reasons: for prescribing treatment tracking wholesome health and prefer psychological wellbeing over plain physiological health.

Sacks was born in 1933 in London into a medical household. Both his parents were physicians and two of his elder brothers are doctors. He was molded to become a surgeon with his father's passion for social medicine and his mother's exuberant zeal in seeing human body in unison with human nature. He was excessively interested in chemistry and marine biology till he moved in 1950s to Oxford and in early 1960s to California to become a resident in neurology and neuropathology. Later he settled down in New York to work at the Beth Abraham hospital. He still works with this hospital and he is the clinical professor and adjunct professor of neurology at Albert Einstein School of Medicine and New York University respectively. He has treated patients with a wide variety of complaints from Parkinson's, Autism, Alzheimer's, and Schizophrenia to Color blindness, and Tourette's and Korsakoff's syndromes. He has received numerable awards and numerous honorary degrees and numberless blessings from his patients.

Sacks has written scintillating narratives in more than 8 books about unusual circumstances that arise in one's life due to the appearance of neurological disorders, which range generally from memory loss, loss of recognition to identity crisis. His writing is dense with medical humaneness sensitized with suffering of his patients. The rare remarkable empathy of Sacks towards every one of his patients is a striking feature in every narrative. His *cure with care* attitude throughout the treatment is exceptional; he has stayed on within the hospital premises to remain accessible to his patients anytime. His life is in fact a reference manual for the finest doctor one can be; he has remained unmarried undoubtedly for the sake of his patients.

There is a kind of democratic quality to Sacks' narratives which are open for anybody to read and immerse in its intricateness. And yet, readers emerge with a consolation at the courage of the patients to face the unimaginable pain or with glee at the incomplete improvement of the circumstances. In fact, readers – even if they haven't acquired such disorders – are either transformed by the momentous suffering of their fellow humans or reminded of the finitude of the human life. Readers are alerted to such wacky illnesses not to succumb to helplessness but to become aware of our limited existence. Most of Sacks' narratives are instances of perpetual human struggle and partial amelioration in the process.

Sacks' Philosophy of Medicine

The great Canadian physician, William Osler, once said that "he who studies medicine without books sails an uncharted sea, but he who studies medicine without patients does not go to sea at all." Sacks has fanatically lived up to Osler's suggestion and has churned narratives out of his patients so much that nowhere in these clinical tales, would the reader find any reference to himself but to his patients and to remedy their problem, Sacks uses the collective "us" referring to everyone involved in the treatment.

Some say medicine began in the Genesis itself when God breathed life into a lump of clay and made Adam. So, it is the primary medical act of breathing life into an organ that must carry on sustenance of life. As Deuteronomy of the Old Testament instructs, we need to choose life over anything else and stand out in the face of any scourge of suffering. Sacks would have learnt it at an early age when he used to visit synagogues and even listen from his father who was a prolific Jewish scholar-physician. The exquisite narrative description of the books of the *Pentateuch* like the *Exodus* and *Numbers* would have been an impulse to his mastery of narrative writing.

For Sacks, narrative writing is salvation from bearing witness to human condition. Medicine has correct diagnosis as its inevitable goal but for Sacks, it is just one among the many perspectives to treat the patient. Since many of the conditions chronicled by him are incurable, the force driving his tales is not the race for a remedy but the patient's striving to maintain his or her identity in a world utterly changed by the disorder. In Sacks' case histories, the hero is not the doctor, or even medicine itself. His heroes are the patients who learned to tap an innate capacity for growth and adaptation amid the chaos of their disordered minds. By restoring narrative to its rightful place in medicine, Sacks has remodeled the way physicians have to deal with their practice. Medicine insularly focused on a patient only as a diseased subject. In his narratives, Sacks has irrevocably restored human selfhood at the centre of his diagnosis. Sacks succinctly explains:

> Our health, diseases, and reactions cannot be understood in vitro, in themselves; they can only be understood with reference to us, as expressions of our nature, our living, our being-here in the world. Yet, modern medicine, increasingly, dismisses our existence, either reducing our existence, either reducing us to identical replicas reacting to fixed stimuli in equally fixed ways, or seeing our diseases as purely alien and bad, without organic relation to the person who is ill. (1990, 228)

This is the starting premise for Sacks to treat his patients who are thought to be transformed by diseases as much as the literature of the diseases is affected by the patients. This is the reason for Sacks to write about the transformative capacity (to whatever little extent) of illnesses in patients and in turn, help enrich neurological literature. For Sacks, patients are not pieces of neurological disorders but an orderless reality with borderless possibilities for recovery.

Sacks has based his philosophy of medicine strongly on another prominent neurologist of 20th century: Alexander Luria (1902-1977), the Soviet neuropsychologist. Luria was one of the first to blend neurological case studies with exceptional narrative style and in the process develop something Luria called the romantic science. Luria was one of the wellsprings of inspiration for Oliver Sacks. Luria used novel ways to describe his extraordinary patients like Sherashevsky who had such vast memory that he could not forget anything and the effects of this indelible memory on his identity and life.

Another patient Zasetsky had a bullet-pierced brain because of which many abnormalities developed ranging from complete loss of perception of right side of vision to memory loss. Yet, Luria developed a unique way to alleviate the pain of the patient. Luria came to know that Zasetsky had an intense interest to write though he lost his reading ability. So, Luria encouraged Zasetsky to plainly write, fearless of any grammatical rules. Luria believed that Zasetsky's introspective writing would become his most reliable form of communication and his reason for living.

Ultimately, Sacks' philosophy of medicine rests on two pillars of doing medicine: identification and understanding. (Sacks, 1990, 226) When a patient meets the physician for the first time, he indulges in identification. This involves recognizing the outward *symptoms*, scurrying for *signs* that are characteristic of the disorder and *tests* to verify or rebut the suspicions. In fact, this has become the general attitude towards illnesses. What happens with pure obsession with identification is put across in a poem by Philip Larkin delightfully:

> Even to wear such knowledge – for our flesh
> Surrounds us with its own decision –
> And yet spend all our life on imprecisions,
> That when we start to die
> Have no idea why. (Drownie, 1995, 269)

But, Sacks' scope of medicine extends to another aspect called understanding. By which, he means the human level of approaching the patient. After completing the technical review of the patient's situation, the physician has to invariably set out into the realm of cure, care and compassion. In fact, this must go hand in hand with the identification phase. A physician should never lose the humane understanding for the sake of diagnostic precision of the disease. Because, as Sacks indisputably points out:

Patients need proper diagnosis and treatment, but they also need understanding and care; they need a human relationship and existential encounter, which cannot be provided by any technology. (1990, 226)

So, identification and understanding have to harmonize each other because as the great Jewish physician-philosopher Maimonides (1135-1204) suggested:

[The remedy for sick souls is to go to] wise men – who are physicians of the soul – and they will cure [the] disease by means of the character traits that they (the physicians) shall teach them, until they make them return to the middle way. (Drownie, 1995, 92)

And the middle way, as Maimonides too pointed, is also Sacks' scruple: to tread a balanced path between identification and understanding, and allay the suffering of the patient by allying him with the reality of life.

Neurological Narratives of Oliver Sacks

Oliver Sacks, in self-consciously practicing narrative medicine, prefers not to reduce and localize the illness to a specific body-part but to look at the inherent inhabitant in the body. It is weird to imagine the incapacity of a husband to recognize the face of his wife with whom he has been life half of his life or a woman who deliberately impairs her hands or a 93-year old man who has to be shown a videotape of his movement to make him realise that he walks tilted. These clinical tales are narratives that will confound the reader with their unusual behavioral patterns that are a result of some damage to a 1.3 kg jelly that sits right on our top: the brain and the nervous system that supports it. Yet, one must remember that the manner and matter of illnesses depends as much on the damages to the brain as on a variety of psychological and sociological factors.

The best part of these narratives is that they are about someone really out there who is facing a nasty reality of his life knowingly or unknowingly. These narratives may alarm readers because of their bizarre descriptions and tribulations. But, at the same time, they also alert readers that they may also face a similar situation in their future. In a sense, these narratives inform the reader immediately of the prospect of contracting such illnesses common to the human situation and a variety of ways to alleviate the situation. As the philosopher-theologian Paul Ricoeur explains:

A story describes a series of actions and events [in which] characters are represented either in situations that change or as they relate to changes to which they then react [and] reveal hidden aspects of the situation and of the characters and engender a new predicament that calls for thinking or action or both. The answer to this predicament advances the story to its conclusion. (1980, 174)

So, Oliver Sacks disrupts his narrative order of outlining the plight of his patient to infuse the narrative with his medical as well as philosophical insights to pause the reader to think while encountering situations that move across from one trauma, joy to another. He is extremely careful in choosing Wittgenstein to elucidate on the role of language or Nietzsche or Kierkegaard for philosophically reading illnesses or the neuropsychologist Alexander Luria or neurosurgeon William Osler to medically interpret illnesses with humaneness. Never does Sacks stumble the reader into distress as he sees an absolute trust between the physician and the patient to be the touchstone of recovery.

Bodiless Narratives

Human brain adapts to new challenges posed to it by coordinating with the whole of human body or simply put, we have an embodied brain. Without the body to interact, brain can be chemically stored but in a soulless void. Brains live in and with bodies. But, sometimes due to a stroke that affects the brain, patient have a false sensation of the some body part. We all have what neurologists call proprioception: an ability to sense the location, position, orientation, and movement our body. Without this, we will be left disoriented and lost in the world. But, shortly after the American Civil War of 1860s, soldiers displayed a peculiar experience: even after unfortunately getting their limbs amputated, they still felt their presence in the body. This was called phantom limbs. Ever since, they have been numerous similar cases with patients being engulfed in such bizarre circumstances where they become incapable of perceiving the absence of certain parts or portions of the body.

Generally, individuals turn into patients because of the onset of some illness. This new labeling of individuals shouldn't discredit them as beings in the world. They only turn into patients due to their entry into a distressing phase of their life from which they may or may not have an exit. The neurologist team is responsible as much as the patient for charting out the path to recovery. The physician must be proactive enough to be sensitive towards the suffering of the patient and that's why we term them illnesses (as they are subjective) rather than diseases (which are nearly objective.)

A 93-year old man young with bustling energy steps into the clinic and Sacks is astonished at his gait. He doesn't walk upright but a certain angle to the floor and the funnies thing is that he is worried over others telling him that he isn't walking normally and moreover he puzzles Sacks with his question:

How *could* I be tilted without knowing I was? (1985, 67)

This incapability to perceive his slanted gait would be really confounding because it is usually unbearable for anyone to be told of anything unusual about oneself through others. It is a typical reaction to the threat of understanding oneself through others.

But, the most fascinating thing about this narrative is that it abounds with self-reflexivity. Before Sacks suggests anything, the wise old man dissects his situation by seeking an analogy from his profession: carpentry. In fact, the neurologist is quite aware that the carpenter is suffering from a disease apparently common in old people: Parkinson's disease. Due to this disease, patients lose their ability for voluntary orderly movement and their muscles become rigid and hands display tremors. Neither does the carpenter know these overt symptoms nor is he aware of the dreaded disease. But, the carpenter breaks through the neurological tags (Parkinsonism) usually assigned to a patient like him and understands his plight through metaphors of his own profession. He puzzles Sacks when he asks him:

[As a carpenter] we would always use a spirit level to tell whether a surface was level or not, or whether it was tilted from the vertical or not. Is there a sort of spirit level in the brain?

[whose knocking out results in Parkinson's] (1985, 69)

For quite sometime, the medical profession has been ruthlessly assaulted for increasing the patient's trauma by tagging them with scary diseases and creepy symptoms. This narrative brings out a fresh outlook towards this allegation suggesting that by allowing patients to reflect on their condition and gain self-understanding about their situation, they themselves may come up with strategies to deal with it. With this assurance of self-sensitivity to their suffering, patients can pool up with physicians to mutually sort out a way ahead. In fact, this is possible in cases where patients retain some self-awareness towards such insightful thought or else it completely depends upon the physician (and his team) to lonely unknot the course of treatment.

Ultimately, the carpenter himself scurries for ways to make him aware that he is walking skewed. Should I use a mirror but I can't self-reflect on myself all the way through? But, this self-healing carpenter thought it through:

'Yeah, Doc, I've got it! I don't need a mirror – I just need a level [that] I can't use the spirit levels *inside* my head, but why couldn't I use the levels *outside* my head – levels I could see, I could use with my eyes?' (1985, 71)

So, the carpenter hints at the possible remedy for his predicament: fashioning a new form of spectacles that would make him aware of his tilted posture. With the help of the neurologist and his team, the carpenter creates a special spectacle that - though awkward – perches on his nose to keep a constant vigil on his posture. These glasses are initially bulky to wear but gradually become wearable. For some recourse to the disease to be jointly amenable to the patient and the physician, there must be an unequal participation from either side in the course of treatment. The same principle can be extended to any relationship in life: until we play our part, we can't expect to move ahead.

A prevalent point that these narratives reveal is that such situations turn into spectacles of insight into our life as we progress through the enveloping of illness as well as engulfed by our self-understanding.

As they say, the partial understanding is itself a progress made towards the whole. Yet, someone like Mrs. S (described in *Eyes Right!*) has a fractional view of the world that makes her imperceptive of the remaining fraction. She cannot view anything to her left, whereas everything to her right is perfectly perceptible. How can one have such an unfair worldview? She had suffered a massive stroke whereby portions to the right of the brain dealing with visual spaces on the left have been damaged. Unlike the proactive old man in the previous narrative, this nearly-old woman doesn't know that she's missing out half of her view. As Sacks explains:

She knows it intellectually, and can understand, and laugh; but, it is impossible for her know it directly. (1985, 73)

But, this intellectual understanding has helped her evolve ways to compensate her invisible left view. Her solution is explained by Sacks in her act of trying to eat up everything in the plate. Mrs. S gets a rotating wheelchair and she takes a complete circular turn to her right until she feels that the food on her left is perceptible for eating. Even after eating out all that's in her view, she may feel hungry or the plate may not yet be empty. Then she takes another complete right turn allowing her to eat out a portion of the remaining uneaten portion on her left.

So, she has to make as many right swivels as needed until she feels bellyful. She could have rotated the plate or using a video system that would mirror her such that she can see the left side on her right on the screen. But, neither of these experiments is amenable to her condition but as Sacks points out:

The matter is so physically, or indeed metaphysically, confusing that only experiment can decide. (1985, 75)

Sacks general approach to treatment involves a metaphysical orientation as evidenced in the above line. But, what does he mean by metaphysical aspect of the medical narrative? By metaphysical, Sacks stacks up the infinitely complex answer behind an infinitely simple question like how is your health. One can reply affirmatively or grudgingly but words are quite inadequate to explain the inside reality and something beyond these expressions is inherent in our existence, and by not acknowledging it, we run into the risk of masquerading our troubled existence as blissful living.

When we deliberately prevent or are scared of our growth, we not only hamper our psychological evolution but also our physiological performance. This has been cussedly noticed in the case of Madeleine in the narrative *Hands*. In spite of being congenitally (acquired at birth but need not be hereditary) blind, Madeleine is a vivacious woman with exceptional intelligence. Yet, she has depended only on others for her growth; she has been babied from birth so much so that she doesn't even learn Braille. Her speech is infested with too many *cannots*, among which the most striking is her self-chosen disuse of her hands, which are for her:

Useless godforsaken lumps of dough [that she doesn't feel to be a part of her] (Sacks, 1985, 56).

In fact, this abandonment of hands is due to the replacement of their function by others' hands. Though she can sense her hands, their use or the perception of hands has been shrunk by the supporting hands around her. In a sense, her environment stalled her growth and the top of it, made her feel as if she doesn't need hands at all. So, right from her birth she has been insulated from attempting to recover her hands. And this was a daunting task as she had to perceive something that she never did in her life, discover their presence and use. Sacks tries to make her recognize the importance of her hands and to do that, she had to learn to use her hands unassisted. One day, without anyone accompanying her and overcome by hunger, she grabs a bagel with her hand and activates her hands progressively to even shape clay molds. Her blindness didn't hamper her adeptness at sculpting objects exquisitely. But, she soon moved on from objects to people:

There were limits, after all, to the interest and expressive possibilities of things [so that] she needed to explore the human face and figure, at rest and in motion. (Sacks, 1985, 60)

It was only for her to discover and explore her true self to realize the latent potentials waiting to blossom out. Further, Sacks writes about another patient who is a simpleton and relatively not as extraordinary as Madeleine. He too has remained handless for most of his life but using the impetus given by Madeleine's case, Sacks motivates him to *use* his hands and he begins to employ them in all kinds of ways. With these two cases, Sacks tries to disprove a pertinent misgiving about individuals:

> The essential achievement of hands proved wholly possible for him as for her [and this clarifies] that intelligence, as such, plays no part in the matter – that the sole and essential thing is *use*. (1985, 61)

Humanist psychologists like Abraham Maslow have brilliantly explained these losses. Body organs have capacities that clamor to be well-used and if the needs of the organs are not satisfied, then:

> The unused skill or capacity of organ can become a disease centre or else atrophy or disappear, thus diminishing a person. (Maslow, 1968, 201)

Scary Surpluses

If the previous section dealt with narratives that are livid with losses of certain portions in the nervous system, then Sacks offsets those narratives with others that abound with excesses in the brain. If losses are characterized by some kind of shortcoming in one's life due to the malfunction of some part in the brain, then excesses are even more terrifying as it reaches extreme ends of human existence.

One can enjoy the experience of extreme exuberance, incredible rapture of the body; but at the same time, one can be swayed to excessive states of involuntary movement and unwelcome liveliness. Euphoric states are often sought after by artists and others as an essential sickness for the mind to journey to the edge of consciousness and reap benefits out of such an experience. But, to stubbornly seek eccentricity nearly nudges individuals into neuroses and gives them a false feeling of wellness. Growth doesn't lie to artificially inducing it in one self but to naturally spark it out in the human situation of everyday sanity.

To be Ourselves We must have Ourselves

On acquiring fatal illnesses, patients are often confounded at the sudden overturn of the familiar world that they experienced before.

Meanwhile, the world in which one was at home gradually retires into a remote world. As memory becomes luxury, people are stripped of their identities and are torn apart from reality. This nowhere selfless existence may not be even perceptible to patients as they move from one confabulation of world to another. One such narrative is that of an ex-grocer, Mr. Thompson (in *A Matter of Identity*) who is mired in:

> Abysses of amnesia [which] continually [open] beneath him, but he would bridge them, nimbly, by fluent confabulations and fictions of all kinds (Sacks, 1985, 104)

This is what one makes of the glimpsing reality out there when affected with what is called a severe *Korsakov's* psychosis. Mr. Thompson replaces the world and self with what has been forgotten and lost. He is caught in cycles of chimeras which manifest as made-up stories about every perceivable situation. Sacks sees, in Mr. Thompson's hypothetical narratives, the need to tell stories about one's encounters in life. In outlining the need for a narrative, Sacks justifies - within his narratives - the nourishment that narratives reward us by their richness of storytelling. Until one enacts the inner drama, he may not be able to live in a logical continuity with life.

Mr. Thompson is tormented by the continuous business of inventing illusions to satiate his inner drive to catch up with reality. This is usually the case with most of us as the Existentialists have regularly warned us that we try to escape reality by erecting a façade of delusions. We mistake the sparkling superficial surfaces of reality to possess the ultimate depth of meaning. Mr. Thompson too presents dazzling surface anecdotes that lack the profundity of meaning. Moreover, what startles us about Mr. Thompson is that he has:

> ...no feeling that he has lost feeling, no feeling *that* he has lost the depths, that unfathomable, mysterious, myriad-leveled depth which somehow defines identity or reality. (Sacks, 1985, 107)

But, say, Mr. Thompson suspends his gibberish for sometime for some aspect of reality to penetrate his chimerical world. Then, it can be expected that something unexpected can happen. Medicine is full of miracles where something unknown unlocks its grace on the patient to redeem him of his suffering. In another clinical narrative (*The Lost Mariner*,) Sacks writes about a former submarine radio-operator, Jimmie. After more than thirty years of the Second World War, Jimmie is caught in time: he still feels that it is wartime. He has typically lost memory and cannot remember anything after the war till today: a vast span of more than 30 years. And when Sacks consults the erudite neuropsychologist, Alexander Luria, he suggests that:

Do whatever your ingenuity and your heart suggest. There is little or no hope of any recovery in his memory. But a man does not consist of memory alone. He has feeling, will, sensibilities, moral being – matters of which neuropsychology cannot speak. And it is here, beyond the realm of an impersonal psychology, that you may find ways to touch him, and change him. (Sacks, 1985, 32)

So, Sacks seeks various ways of Jimmie's redemption from this memory blackout; but with a haunting question: does he have a soul at all to be recovered or that too has been drowned by the disease? The solution Sacks finds in Jimmie's marvelous conduct in the chapel:

He was wholly held, absorbed...there was no forgetting...for he was no longer at the mercy of faulty and fallible mechanism – that of meaningless sequences and memory traces – but was absorbed in an act, an act of his whole being, which carried feeling and meaning in an organic continuity and unity...so seamless it could not permit any break. (1985, 36)

In hopeless neurological situations, patients like Jimmie can still find a communion with the spiritual *Ground of Being* to reconnect them with their truer self. But, in the case of Mr. Thompson, even this reconciliation seems unlikely. Whenever he is among the crowd or enclosed by things, Mr. Thompson frenziedly and superfluously connects with them by a veritable delirium of identity making and seeking. But, if supplied with solitude, he nevertheless experienced a spiritual communion with something other than himself. Though there was no marked recovery in his situation, this quite time he had for himself could give him a respite from his uncontrolled chatter.

Usually, we experience nearly controlled movement in most of our daily activities. If we accidentally stumble in our movement, we may feel embarrassed and correct it immediately as we are conscious of such slip-ups. But, there is a typical situation where one experiences involuntary movement abundant with nervous energy, extreme emotions and excessive motions, terrifying twitches (called tics). This is called the Tourette's syndrome. One such patient's narrative is the most famous oft-cited *Witty Ticcy Ray.*

Ray is a 24-year old dilettante who is thrilled as much by his jazz-drumming as with his tics. He was fired from his jobs because these tics tripped him into sudden outbursts of excitement and surpluses of irritation. Yet, he was endowed with a keen musical sense that was floridly displayed during his weekend jazz drumming. His tics tapped into his dexterity at drumming - discounting him of any upsetting situations as such. He lost himself to music to recover in other situations to be thwarted by tics.

A person suffering from Tourette's syndrome seems to be living in a public dream of his private unconscious as he is disoriented and dissociated with his surrounding world. This psychoanalytic aspect of the syndrome refutes the obsession of most neuroscientists today that psychoanalysis is a defunct discipline.

Anyhow, Sacks – on learning about a new drug (haldol) that could abate the tics of Touretters – gave a minute dosage of it to Ray. When he turned up a week later, he walked into the clinic with a black eye and broken nose. As a Touretter is often lured by "spinning things and revolving doors," Ray – managing with a minute dose of Haldol – had mistimed his movements and ran into the revolving doors to get knocked out. The drug had reduced the intensity of the tics and this cutback had affected his normal movement and reaction itself. So, neither can tics be completely abandoned nor can their overabundance be tolerated. Because as Ray himself admits:

Suppose you could take away the tics... What would be left? I consist of tics- there'd be nothing left. (Sacks, 1985, 93)

This is what usually happens with patients enduring extreme suffering: their identity aligns with the illness; their self sums up with symptoms. Sacks, in just giving us few details and administering the drug, had experimented with the drug's effect and this narrative proves the inadequacy of a pill for every ill. Just by spotting the symptoms, labeling patients with diseases (especially in the case of mental illnesses) and delivering them over to drugs, can never help the patient. Drugs and scans are a part of the treatment; not the whole treatment itself.

For the physiological imbalance to be transcended, the existential balance has to be enriched. Though Ray was continuously drowning himself with the disease, Sacks examines Ray's life with and without Tourette's. He collaborates with Ray on a three-month ordeal about Ray's hidden potentials that survived unexplored during his 20 years of endurance with the disease. Even Freud devoted a protracted time (sometimes years) to his patients in understanding their tribulations; but, ultimately for the benefit of maximally diagnosing their illnesses. Sometimes, a lack of such commitment to the patient results in what Sacks had done to Ray in drugging him with haldol. But, it is the wisdom of Sacks to renounce such isolated approaches and reconcile with Ray in coordinating with him to discover an amenable treatment with him. This co-working with Ray resulted in a reuse of haldol on Ray but now with a better understanding of the potentials of the patient and the physician by each other, the ill-effects (that arose earlier) are absent.

Living with Tourette's from the age of four, Ray was fascinated by the disease so much that he was not willing to give it up. Because of the three moths of deep preparation and analysis, he has now skimmed out the surface obsessions with the disease to plunge into the profound depths of his personality. Ray and Sacks etch out a prodigious plan to help Ray enjoy a normal life as well as the extraordinary life that tics had provided him:

> [Ray] would take haldol 'dutifully' throughout the working week, but would take himself off it, and 'let fly', at weekends... There is a sober citizen, the calm deliberator, from Monday to Friday; and there is 'witty ticcy Ray', frivolous, frenetic, inspired at weekends. (Sacks, 1985, 95)

The dullness that haldol drowned Ray during weekdays was nevertheless unequally compensated by the vivaciousness of off-haldol weekends. In finding this balance in life, Ray reminds the equilibrium with which one has to negotiate his inner freedom with outer captivities.

A Child follows the Bible before he follows Euclid

Finally, a neurological narrative in which the patient herself *uses* narratives to connect with an otherwise empty meaningless world. *Rebecca* was a physiologically grown-up girl of 19 but was psychologically still a child. She was – to use a medically derogatory word – a "retarded" child colored by utter confusion and clumsiness of activity, complete withdrawal from the outside world, along with a wide variety of cerebral and mental defects. Our general attitude toward people like Rebecca is to flush out pointless sympathy (originating from pity) whereas the least that was needed was to empathize with Rebecca and make her feel at home.

Orphaned at an early age, Rebecca was cared by her loving grandmother. Though Rebecca could neither write nor read, she listened to stories and poems recited by her granny, who almost enacted them in her majestic voice.

Though Rebecca seemed utterly emotionless, she was deep down an adoring girl with profound love for her grandma. In spite of her incapacity with simple principles and instruction, Rebecca wanted the world to be re-presented to her in verbal images, in language, and seemed to have little difficulty following the metaphors and symbols of even quite deep poems. Though abstract concepts were imperceptible to her, she absorbed herself in concrete poems and coalescing narratives. Rebecca may be crippled intellectually but spiritually somewhere deep down her soul, she had a spiraling sense of completeness.

Unlike other narratives in the book, Sacks, in *Rebecca*, speaks with a special sincerity. Initially, he mentions all the noticeable signs and symptoms of Rebecca to confirm her shortcomings. Later, he is awestruck at her profound insights and observations in her delightful encounter with nature. Sacks first saw her – with a *neurological vision* – as a casualty whose impairments were diagnosed with precision. Next time, he saw her – with his *human vision* – to be baffled at her beautiful vision of nature. Rebecca would be spellbound by nature and lose herself among the flora and fauna - stilled by moments of illumination and contemplation. She was also a devout Jew who may have been similarly wondered in synagogues by the tale of Moses who brought down from Mt. Sinai, not just the guidebook of God but the overwhelming wonder of God. Marveling at the Cosmos is an available experience to all of us but we are deliberately turning it into an unaffordable luxury.

Deficits were so promptly diagnosed that what was outside those deficits was blatantly neglected. Tests and scans could never show these inherent abilities of Rebecca and it is always advisable for the physician to treat the man not the scan. Though she was *de-composed* by her deficits, she *re-composed* herself with a stillness that – as Sacks analyzes – emerged out of her fondness for tales, for narrative composition and coherence. This is what most physicians tend to ignore:

...Evaluations [display] deficits [masking us from the patient's] powers...they only show us puzzles and schemata, when we need to see music, narrative, play, a being conducting itself spontaneously in its own natural way (Sacks, 1985, 172)

Narratives – derived out of watching and wondering about nature – helped Rebecca to reconfigure her world and re-place herself as a worthwhile participant in it. Even when her storytelling grandma died, Rebecca acts with great poise and dignity – reacting to a dear one's demise with an unretarded touching mourning. When Rebecca was advised and attended some workshops and classes, it didn't work as she was constantly reminded her of her limitations because as Sacks so wonderfully puts it:

...we were far too concerned with 'defectology', and far too little with 'narratology', the neglected and needed science of the concrete. (1985, 174)

Narratives come naturally handy for us to deal with a wide variety of situations in life; Bible is easier to follow as it is "cast in a symbolic and narrative mode." (ibid, 175) Rebecca searched for that one narrative in life that could give her a genuine meaning and she expresses it in an amazing analogy:

I'm like a sort of living carpet. I need a pattern, a design, like you have on that carpet. I come apart, I unravel, unless there's a design. (ibid, 175)

In the changing patterns of life, Rebecca was searching for that distinctive pattern that would give her a glimpse of her life's true meaning and purpose. At last, she herself expresses her love for theatre. She is enrolled into a theatre group, where in the shifting patterns on the stage, she dons various roles and does exceedingly well in spite of her mental deficits. Unless we find what is that which kickstarts the real self in us, every one of us are virtually mentally defective. Narratives are everywhere around us; it only takes a keen inner eye to pick out the perfect narrative and engage in the everlasting episodes of self-realization.

A Starting Conclusion

> ...it is silly
> To refuse the tasks of time
> And, overlooking our lives,
> Cry – "Miserable wicked me,
> How interesting I am."
> We would rather be ruined that changed,
> We would rather die in our dread
> Than climb the cross of the moment
> And let our illusions die.
>
> — W.H. Auden, *The Age of Anxiety*

Almost all these narratives are sewn with strands of the patient's awakening to the presence of some illness, the physician's diagnosis and deliberations, the ensuing tribulations and revelations. But, there are knots of existential dilemmas that must be unknotted in the process of ultimately fashioning the cloth of health. Neurological narratives challenge us with their complexity in realizing the constraints of human existence. The so-called *healthy* readers are confounded by the others' *illnesses* that the reader has to rethink about what it means to be hearty and healthy.

In fictitious narratives, readers are asked to cognitively fill in the gaps left open by the author so that the meaning of the text is completed by the active involvement of the reader. Paradoxically, in neurological narratives, readers are not only required to bridge the breaks in the text outside them. But, there is a stronger emphasis to refill and renovate their selves with novel understandings from participating in making the meaning of the medical narratives. When these narratives decompose the line separating illness and wellness, the reader is handed over the responsibility to make a meaningful judgment about the dividing line. In fact, as this subject is quite subjective and unique to every individual, it is audacious for the psychiatrist or neurologist to pass an absolute ruling on it.

Whatever may be the degree of outside relief a patient can get like drugs and therapy, it ultimately rests with the patient's unassailable inner self to promote his psychological health. Actually, the way in which the organs disobey the human will and degenerate into disorders reflects the manner in which an individual willfully collapses into his cocoon of cravings and revels in his separateness.

Medical facts keep on restocking the infinite space created by myriad possibilities of human pathology and health. Every medical procedure is only a step closer to the source of illness whereas it is inherent in illnesses to take an astonishing form. As soon as a physician offers certainty of curing an illness, there are new manifestations of the illness as its biological variability and the ever-changing human condition are inbuilt into it. So, listening to thousands of years of medical advice, it is always favorable for patients to have as much as self-understanding as possible to brave and combat illnesses. Until we acknowledge our innate natural levels of suffering of being born as a human, we cannot grow over them and overpower them with our uniqueness of being a human.

What has been lost is the capacity to experience and have faith in one's self as a worthy and unique being. At the same time, we have distanced ourselves from our fellow human beings to such an extent that we have *made* ourselves incapable of acknowledging our separateness - let alone experiencing it. This disharmony with others can be resolved by the sufferer as he alone has got the freedom to pick among these three choices:

The effects of suffering...may stimulate in the sufferer a conscious or unconscious craving for intensification of his separateness; or it may leave the craving such as it was before the suffering; or finally it may mitigate it and so become a means for advance towards self-abandonment and the love and knowledge of God. (Huxley, 1972, 263)

Most of the patients in the neurological narratives have made one among these choices outlined by Aldous Huxley and lived with till they turned into patients. Then, they have sustained their choice or preferred another choice that has changed their very mode and functioning of life.

As was observed before (see page 10), the marked manifestation of suffering is existential anxiety, which as patients are awakened takes the form of:

...apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality. (May, 1977, 80)

Threats can originate from the body or the psyche but one must remember that there is no threat-less existence in anyone's life. As long as individual hold a variety of values central to their existence, they have to encounter anxiety but not succumb to it. Instead, this anxiety-rich existence gives us ample opportunity to rekindle our untapped possibilities and refurbish our self. Illnesses often lead to redemption as the self is nearly emptied of all humdrum of outside quotidian existence and focuses on the inner promise of potentials.

As the awareness of existence expands, the patient discovers what value is threatened and becomes aware of the conflict between his goals and how these conflicts have developed. Then, the individual restructures his goals, makes a choice of values and proceeds towards the realization of these values responsibly and realistically. In the recovery and reorganization of the self, patients may experience self-realization that is:

...the expression and creative use of individual capacities [which] can occur only as the individual confronts and moves through anxiety-creating experiences. (May, 1977, 354)

Enriched by anxiety-creating experiences, the patient becomes creative and constructively deals with the prevalent situation readily and responsibly. Then, a surfeit of possibilities emerges and selfhood gets strengthened. But if:

...individuals seek to avoid anxiety, responsibility, and guilt feeling by refusing to avail themselves of their new possibilities, by refusing to move from familiar to unfamiliar, they sacrifice their freedom and constrict autonomy and self-awareness. (May, 1977, 356)

So, every one of us everyday combats with the *illness* of preserving our autonomy continuously assaulted by nothingness in life; yet, there are infinite possibilities for us to overcome the debilitating distresses in life and it is only up to us to do so. And one of the ways is to perpetually wait for a wise "storyteller [to bless]...an unending [unfinalized] world [with] the bliss of untold stories." (Ashok, 1998, 128)

References

Ashok, AV. (1998) *Narrative: A Student's Companion*. Chennai: TR Publications.

Auden, W H. (1976) *Collected Poems*. Ed. Edward Mendelson, London: Faber and Faber.

Brown, JAC. (1985) *Freudians and Post-Freudians*. Harmondsworth: Penguin.

Drownie, R.S.(1995) *The Healing Arts*. New York: Oxford University Press.

Fromm, Erich. (1986) *Psychoanalysis and Zen Buddhism*. London: Unwin Paperbacks.

——————————. (1968) *Man for Himself*. New York: Fawcett Premier.

——————————. (1968a) *The Sane Society*. London: Routledge Paperbacks.

Huxley, Aldous. (1972) *The Perennial Philosophy*. London: Chatto & Windus.

Macquarrie, John. (1978) *Existentialism*. New York: Pelican Books.

Maslow, Abraham. (1968) *Towards a Psychology of Being*. New York: D Van Nostrand Company.

May, Rollo. (1979) *The Meaning of Anxiety*. New York: Pocket Books.

Polkinghorne, Donald E. (1988) *Narrative Knowing and the Human Sciences*. Albany: State University of New York Press.

Porter, Roy. (2002) *Madness: A Brief History*. London: Oxford University Press.

Ricoeur, Paul. (1984) *Time and Narrative Vol I* trans. Kathaleen McLaughlin and David Pellauer. Chicago: Chicago University Press.

————— (1980) *Narrative Time, Critical Inquiry (7) Autumn.*

Sacks, Oliver. (1985) *The Man Who Mistook His Wife for a Hat and Other Clinical Tales*. New York: Summit Books.

————— (1991) *Awakenings*. London: Picador.

————— (1991) *Uncle Tungsten*. London: Picador.

Scott Jr., Nathan. (1978) *Mirrors of Man in Existentialism*. Nashville: Abingdon.

Tillich, Paul. (1977) *The Courage to Be*. New York: Yale University Press.

White, Hayden. *The Value of Narrativity. Critical Inquiry 7 (Autumn 1980).*

Meditation: Brain Activity and Cognitive Changes

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Introduction

In the past few decades, self-regulation of physiological processes has received immense attention from the psychology and neuroscience communities. The complex task of meditation is an important self-regulatory process that is practiced world over. The process of meditation is associated with certain aspects of consciousness i.e. the human "altered states of consciousness" and its phenomenological experience. The problem of defining consciousness and explaining the relationship between physical and mental is one of the oldest and most important questions of philosophy and science. According to Chalmers (1995), "consciousness poses the most baffling problems in the science of mind. There is nothing that we know more intimately than conscious experience, but there is nothing that is harder to explain". Despite the rich first person descriptions, very little is known about brain or cognitive mechanisms that give rise to such altered states of consciousness like meditation. Meditation can be defined in various ways. According to Farthing (1992), "Meditation is a ritualistic procedure intended to change one's state of consciousness by means of maintained voluntary shifts in attention" (Farthing 1992). According to Wallace and Fisher (1991), "Meditation can be regarded as slow unmutative long-term procedure for producing an altered state of consciousness". Meditation significantly differs from other altered states in terms of its method of induction (driven by voluntary processes), long-term behavioural changes due to meditation and phenomenal experience associated with meditation. The meditative states can be accompanied by states of exceptional concentration, clarity, perceptual sensitivity, transience, optimism and ineffability.

A general approach to meditation that draws heavily on cognitive science and neuroscience sees both *state* and *trait* changes due to meditation as a resultant of brain activity and related to cognitive processes like attention. Although there are constraints of empirical data and cognitive dimensions of these experiences across various types of meditation, the emphasis is to extend meditation research from the realm of speculation and anchor it against a neurocognitive basis. An important sub-discipline in cognitive science that makes such an attempt is cognitive neuroscience which brings together cognitive psychology and neuroscience to study cognitive processes in the brain (Gazzaniga et al., book).

The emergence of cognitive neuroscience is not only linked to studying a conscious brain in action but also to link phenomenological, psychological and neural levels of explanation. Cognitive neuroscience involves methodologies ranging from electrophysiology, psychophysiology and neuroimaging that are employed to study all cognitive processes including meditation. A cognitive neuroscience of meditation focuses on finding out the cognitive faculties of meditation linking brain activity with meditative experience and behavioural changes due to meditation. We emphasize the findings from the cognitive neuroscience approach for understanding meditation in this paper.

Before we explore the changes in brain activity and cognitive processes due to meditation, we discuss different methods of meditation and highlight some similarities and differences between different methods of meditation. We also summarize findings from some important behavioural and neuroscientific studies on meditation.

We discuss some of the implications of these studies in understanding the mechanisms underlying meditative experience.

Methods of Meditation

Meditation is primarily considered to be a process of calming the mind. Most methods of meditation have religious origins such as Buddhism, Hinduism, and Sufism in particular but comparable methods have been found in other traditions too such as Christianity, Judaism and Islam. Most recently secular methods have appeared which train people in meditation without focusing on any religion. The most popular meditation techniques are Transcendental Meditation (TM), Sahaja Yoga meditation, Kundalini meditation, Raja yoga, Bhakti yoga etc. (Satprakashananda, 2004). Meditation usually involves sitting in a special posture and keeping the body alert but relaxed at the same time. The best-known posture is the *full lotus* position forming a stable triangle of contact with the floor. It requires one to sit in an upright posture with straight back and encourages breathing from abdomen rather than chest. Other postures include *half lotus* and simpler *Burmese position.* There are several hand positions related to these postures in different types of meditation.

Meditation can be categorized mainly into two types – *mindfulness* or open meditation and *concentrative* meditation. The mindfulness meditation allows any thoughts or feelings to arise while maintaining a specific attentional stance whereas the Concentrative Meditation involves focusing on specific mental or sensory activity like a repeated sound (*mantra*), an imagined image or any specific body sensation such as breath. Mindfulness meditation allows awareness of the phenomenal field as an attentive and non-attached observer without judgment or analysis. Mindfulness meditation allows maintenance of an attention in a state of open perceptivity while concentrative meditative forms allow narrowing of attentional focus. Forms of yogic meditation, TM, Buddhist Samatha meditation that focuses on sensation of breath are some forms of Concentrative meditation.

Open or Mindfulness meditation is usually practiced with eyes open or half open and in Buddhist meditation or Zazen (Austin, 1999) it's often done facing a blank wall. The basic idea is to be continuously mindful, attentive and fully present in the moment paying attention to anything and everything. It is done without making any discriminations and treating every stimuli with equal importance. One of the interesting effects of this is that sights, sounds, events and thoughts pierce into the attention and mind is continuously distracted, categorizing and commenting on everything that happens. With practice Mindfulness meditation leads to what is known as *bare awareness / bare attention* which means never giving in to distractions or desires and being open to everything all the time.

In one of the experiments where people rounded around a blue vase to concentrate on it and restrain all distractions, striking effects related to the perception of the vase were observed (Tart 1969). The vase appeared more vivid, rich and even more luminous as the meditation progressed. It was argued that we normally start increasingly attending to thoughts and distractions and so our perception becomes automatized and dull. The effect of Concentrative meditation was "deautomatization". However, in Zen Buddhism and in particular in Rinzai School, practitioners concentrate on a *koan* or *hua tou,* which are questions or stories designed to challenge the intellectual mind. These are asking the meditators to think of nothing good or evil but of the original features before their parents gave birth to them. These *koans* are not to be understood with ordinary logic but one must penetrate to the state of mind, which they express. Usually a graded series of *koans* is used which focuses the student's mind toward *satori* and gives the Zen master a means of judging the progress of the student. All of these more advanced meditations require supervision.

The conceived objectives of various practices are as follows: (1) a heightened awareness of physiological and psychological processes leading to their voluntary control, (2) inducing psychobiological and psychotherapeutic effects, (3) effecting changes in different aspects of mental functioning and personality, and (4) inducing changes in interpersonal and social behavior. The aims of these practices are understood as the development of insight into the nature of mental functioning, consciousness, identity and reality. To achieve these objectives, many postures and methods are used for meditation and some of these are discussed below:

- *Sitting Meditation:* The classic sitting meditation is a vital part of all the meditation techniques and has many forms. Some traditional approaches involved the student to sit motionless for hours. All forms of classic sitting meditation are done in silence. The meditator is required to sit cross legged Asian style on a meditation pillow on the floor or use the recliner chair method described below. Eyes may be fully open, half open, or slightly open, letting in only small slits of light. Meditating with eyes fully closed is allowed as long as the room remains brightly lit so that enough light passes through the eyelids which would keep one alert.

- *Sit-Stand Method:* This form of meditation was introduced as a defence against sleepiness that involves breaking up formal meditation into three 15 minute sessions. It involves sitting quietly for 15 minutes and then standing for 2 minutes, repeating this thrice. The goal here is to become meditative continuously.

- *Recliner Chair Method:* With this method one can sit in a recliner chair with the soles of the bare feet pressed against each other and your legs relaxed, knees pointed out to the sides of the chair. Hands are generally locked together, laying comfortably on the lap, or pressed against the centre of the chest, one on top of the other. This method of sitting can be used in conjunction with any of the sitting meditation techniques described earlier.

- *Self-inquiry Incantation:* This type of method involves asking some questions to one's own self and performing certain hand gestures like making right hand into a fist and hitting with upturned left palm. The meditators are thus able to resonate the questions that arise deep inside while thinking of their intellectual explanations which progresses into further contemplation. This questioning technique is used only at the beginning of formal sitting meditation sessions.
- *Mirror Gazing:* Some of the practitioners of meditation have been found to use a mirror which is believed to virtually double the power of their meditation sessions. It requires one to sit in front of the mirror and gaze onto the reflected image, setting the focus on just above the head so that the wall behind could be viewed.

Out of the methods of postures described above, sitting type of method is most widely used. Besides these, there are several other traditional techniques which involve focussing certain aspects of the body such as body-parts, breath, etc. The Taoist meditation requires one to direct attention towards the centre of the torso at about the level of the navel. Thoughts, when arise should be placed in this centre of the body as if they arose there. This method especially helps to promote a feeling of vitality and strength from the belly. Breathing is a function which may be either voluntarily or involuntarily controlled. To meditate on breathing is to deal with how you allow your spontaneity to flow. The breath concentration as used in Japanese Zen Meditation involves shift of attention to the lower part of the body, the pelvis or the abdomen, accompanied by relaxation. The meditators are instructed to inhale in air maximally and then exhale maximally while counting each exhalation and descending their attention and thoughts down to the stomach. Another group of meditative exercises focuses the attention directly on the contents of consciousness, drawing on yoga practices. Here the meditators are asked to do nothing and to think nothing to let go ones feelings and ideas. Sudarshan Kriya Yoga is another popular technique of meditation which involves certain specified rhythms of breathing, whereas the Transcendental meditation is practiced with sitting quietly with eyes closed.

Meditation has been a subject of deep study, research and experiment from times immemorial. A variety of meditative practices have been developed and systematized in different spiritual traditions over several centuries especially in the Indian tradition. Meditative practices first commenced in the background of Vedic religion as a tradition known as *upasana.* The word literally means "sitting near". *upasana* is objective meditation. Objective Meditation involves concentration of mind on an object, which may be a deity, light, sky or some qualities like love, compassion or ones own self objectified. In *upasana* attention is focused on an object by the effort of the will. S*amyama* has been described as a nature-oriented meditation by some of the followers of meditation in Indian context. Unlike u*pasana* whose focus is the principle of consciousness, *Samyama* is centered on the unconscious principle. Concentration practiced is essentially a process of *nirodha* (suppression) and object of concentration chosen for meditation is any concrete form or idea or feeling, because *smayama* is not governed by any rigid conceptual framework.

Buddhism has incorporated many procedural elements of both *upasana* and *samyama* that existed in India even before Buddha was born. The goal of buddhist meditative practices are to realize the emptiness of the self and are called '*bhavana*' in buddhism one can find both objective and subjective types of meditation. *Samartha* is mental concentration and is a type of Objective meditation practiced in Buddhism. Tibetan Buddhists are specialists in this kind. Vipassana is the well-known example of subjective meditation practiced in Southern Buddhist tradition. It is analytic method, which involves constant mindfulness and awareness of all experiences. The tantric tradition started developing with the end of Vedic Period. Some of the important changes introduced by tantric tradition to meditative practices in India include replacement of vedic images of fire, sun, air etc., with images of gods and goddesses; indirect approach to ultimate reality with use of words with purported mystic power to produce changes in consciousness.

Scientific Studies on Meditation

The self-regulatory processes of meditation and yogic relaxation procedures have received mounting interest from cognitive scientists and neuroscientists. This growing research bears upon time-honoured questions such as the nature of conscious experience, mind-body problem and other inter-related areas of consciousness (Schwartz & Shapiro, 1978). Approaches including psychophysiology and neuroimaging have been used to investigate the neural mechanisms and brain activity changes accompanying meditation. Psychophysiology includes electroencephalogram (EEG) and event related potential (ERP) studies. These techniques have also been used to study cognitive processes such as attention (Desimone & Duncan, 1995, Hillyard, et. al., 1998, Luck et. al., 1997), emotions (Lane & Nadel, 2000), and language (Geschwind, 1965). These techniques have also demonstrated changes in brain activity as well as physiological state due to changes in the states of consciousness that differ from the normal state of consciousness (Aftanas & Golosheikin, 2003, Arambula, et. al., 2001, Deepak, 2002, Newberg, et. al., 2001, Young & Taylor, 1998). Thus, it provides a way of measuring changes in cognitive functions due to changes in these states and correlating it with the normal states of consciousness. Based on these studies, it has been proposed that these ASCs are the result of dynamical and constantly interacting neural activities between cortical and sub-cortical regions.

EEG Studies

The history of electroencephalography, the measurement and study of brain's electrical activity began in the late nineteenth century when advances made in the science of electromagnetism began to be applied to human physiology. In the late nineteenth century, a technique was developed for detecting the electrical activity from the exposed surfaces of the brains of the animals, demonstrating the ability to detect electrical brain responses to stimuli. Later, these electroencephalographic techniques were developed to be applied to the humans (Berger, 1929). This discovery promoted several other discoveries and findings related to brain activities while performing different cognitive tasks. The normal human EEG has a frequency content of 0.5 to 30 Hz which is usually subdivided into four or five bands: delta (0.5 to 3.5 Hz), theta (3.5-8 Hz), alpha (8 to 12 Hz), beta (13 to 28 Hz) and gamma (28+ Hz). Each of these bands is correlated with specific brain/behavioral states. Delta frequency is generally associated with deep sleep, theta waves with light sleep or dreaming, alpha waves with relaxed consciousness and beta/gamma waves with active consciousness. Modern computerized EEGs can provide immediate information of brain's large-scale electrical activity according to location, frequency and amplitude. This information can be utilized to identify specific functional/cognitive states of an individual.

EEG is a crude method that measures summed up post-synaptic electrical activity of the neurons especially in the cortical areas. EEG is typically recorded by placing the electrodes on the scalp. EEG recorded without any external stimulation is called spontaneous EEG (or just plain EEG). These recordings are done at various scalp locations that are chosen according to International 10-20 system (Jasper, 1958) or expanded versions of this system. EEG recorded as a response to external stimuli is called an Event-Related Potential (ERP). The positive and negative peaks in ERPs that are obtained after sampling and averaging of time-locked electrical potentials can be described in terms of their characteristic scalp distribution, polarity and latency (Cacioppo et. al., 2000). It has a widespread use as a diagnostic aid and clinical tool for various neurological disorders (Albuquerque et al., 1976; Kolb & Whishaw, 2003; Rechtschaffen & Dement, 1967). EEG and ERPs have been used to study various cognitive processes as well as altered states of consciousness like sleep, dreaming, and meditation.

There has been a plethora of electroencephalographic studies on meditation, but no clear consensus about neurophysiological concomitants of meditative practice has emerged so far. Sensory evoked potential and cognitive event related potential assessments of meditative practices also reflect variegated results. Some reliable meditation related EEG-frequency effects for theta and alpha activity, as well as EEG coherence has been observed.

An initial EEG study performed with subjects under eyes closed condition showed decreased sensory input and increased alpha output predominantly over the occipital scalp (Berger, 1929). Since then the researchers have tried conducted a large number of EEG and fMRI studies and have tried to correlate the results for understanding brain activity associated with states of consciousness. The association between EEG and fMRI has shown increased alpha power being related to decreased blood flow in the inferior frontal, cingulated, superior temporal and occipital cortices (Goldman et. al., 2002). Pre-dominance of alpha power of EEG was observed during meditation as compared to the control conditions has been observed in several eeg studies done with different meditation types (Anand et. al., 1961, Aftanas & Golosheikin, 2003, Arambula et al., 2001, Banquet, 1973, Wenger & Bagchi, 1961). It has been argued that the dramatic increase in alpha abundance is not particular to meditation but it is the unusual ability of the meditators to maintain the alpha activity after the end of meditation with eyes open and diffusion of large amplitude alpha waves to anterior region that characterizes meditational state from other states (Banquet, 1973). Thus increase in alpha power has been reported not just during meditation but also during the baseline condition. Critical change in EEG activity may also be related with clarity of transcendental experience. It was reported that a highly accomplished Japanese Yogi and the founder and Director of a school of meditation, who practiced Kundalini Yoga meditation produced five fold increase in alpha band activity during the meditative practice and only moderate increase in theta after meditation. The moderate increase in theta activity could be associated with the feelings of pleasure.

The effective generation of an altered state of consciousness by experienced meditators was found to be associated with increase in local theta and alpha power over the anterior cortical regions as well as theta coherence in the antero-posterior direction. The increased theta power in these cortical areas is associated with increase in orientation response, concentration of attention and processing of emotional information (Aftanas & Golosheikin, 2003). Recently it has become more evident that the emotional cognitive component in humans is connected with increases in theta rhythm that relates to the cortico-limbic interactions. Increased theta activity was also found to be associated with proficiency in meditative technique (Aftanas & Golosheikin, 2002, 2003). So several studies point out that increase in the power of theta frequency band marks the state specific to meditation rather than increase in alpha power (Aftanas & Golosheikin, 2003, Anand, 1961, Fenwick et al. 1977).

Besides changes in the alpha and theta frequency bands, alterations in the higher amplitude gamma frequency bands have also been observed due to long-term practice of meditation. Long-term Buddhist practitioners were found to induce high amplitude gamma band oscillations and phase synchrony that differed from the controls over fronto-parietal regions during meditative and post-meditative periods (Lutz et. al., 2004). The EEG gamma band source localizations have also been found to be different meditation types i.e. whether focusing on verbalization or visualization (Lehmann et al., 2001) that is consistent with our present knowledge about the neural circuitries. The long distance synchrony is thought to reflect large scale neural co-ordination (Varela et al., 2001) and can occur when two neural populations recorded by two distant electrodes oscillate with a precise phase relationship that remains constant during a certain number of oscillation cycles. There was also a positive correlation found with the hours of practice of meditation (but not with the age) and EEG activity. Thus the baseline activity during resting state of brain may be altered by long-term meditative practice.

Assessment of EEG coherence refers to the squared cross-correlation between EEG powers from two scalp locations within a frequency band and indexes the functional co-variation of activity among different cortical areas. There is an increase in theta range coherence in the frontal region intra and inter-hemispherically during meditation (Travis et. al., 2002, Aftanas & Golosheikin, 2003). Higher levels of coherence are associated with functional coupling, functional co-ordination and information exchange between brain regions.

Given the spectral changes accompanying meditation, sleep and drowsiness states have also been compared with meditative states. Several EEG studies have reported sleep like stages with increased alpha and theta powers (Pagano et al., 1976). Subsequent studies have tried to differentiate states of drowsiness and sleep from meditation. While meditation produced continuous trains of theta activity at a constant frequency, drowsiness produced a mixture of alpha, low delta and theta frequencies. Theta waves were also found to persist in post-meditative period with eyes-open (Banquet, 1973). Several studies have hinted on meditation being the state that is suspended between wakefulness and sleep and EEG can distinguish between meditation, sleep and baseline conditions (Fenwick, 1987, Fenwick et al., 1977, Young & Taylor, 1998). Recent PET studies have also started elucidating neural substrates associated with meditative and hypnotic states (Kosslyn et al., 2000, Lou et al. 1999, Maquet et al., 1999, Rainville et al. 1999). Thus states of consciousness are being associated with different patterns of activations depending on the content of consciousness or the mode that leads to a specific state of consciousness.

Some of the advanced EEG studies like the low resolution tomography algorithm (LORETA) of EEG signals selects the smoothest of all possible three-dimensional current distributions to localize scalp signals in a manner comparable to fMRI (Cahn & Polich, 2005). The results of LORETA studies have reported of EEG gamma activity that differed significantly between five different types of meditations. During volitionally self-initiated altered state of consciousness that were associated with different subjective meditational states, different brain neuronal population was found to be active. The brain areas predominantly involved during self-induced meditation aimed at visualization (right posterior) and verbalization (left central) were agreed to have different functional neuroanatomy. The brain areas involved in self-induced meditational dissolution and reconstitution of experience of self activated at right fronto-temporal regions. This is suggestive of the fact that altered states of consciousness are associated with different patterns of brain activations depending on the content of consciousness, which the above mentioned studies continuously point out. It is evident from the above mentioned studies that there exist certain asymmetries in brain activations due to meditation. There is also problem gaining an accurate measure due to variable experimental conditions and differences in the types of meditation. Yet, a number of EEG studies on meditation propose that a fundamental part of the neural substrate for this particular state of consciousness is likely to involve a specific kind of brain activity irrespective of the extemporaneous effects.

Neuroimaging Studies

A close analysis of a number of neuroimaging studies on meditation with different forms of meditation show significant increase in activations in the cingulated gyrus and the prefrontal cortices especially the dorsolateral (DLPFC) and orbitofrontal areas of the frontal cortex (Lazar et al., 2000, Lou et al., 1999, Newberg, 2001 & 2003). The increased activity of the DLPFC may contribute to self-regulation of brain functioning as it has been shown to contribute to self-regulating emotional reactions and also preparation for voluntary action. The orbital prefrontal cortex is said to have a role in the circuit for emotional processing and the cingulated cortex is more active while attaching motivational significance while selecting the appropriate response. All the three areas are also involved in the network for selective attention (Kolb & Whishaw, 2003). A PET study with yoga meditators showed an overall increase in activities in bilateral hippocampus, parietal and occipital sensory and association areas across all phases of meditation along with a general decrease in orbitofrontal, dorsolateral prefrontal, anterior cingulate, temporal, inferior parietal and other limbic as well as brain stem areas (Lou et al., 1999 in Cahn & Polich, 2005). The symbolic representation of self and body sensations can be correlated with increased parietal activations; limbic system is involved in emotional processing and the brain stem regions in volitional motor acts. There are yet other neuroimaging studies that show increased activity in the neural structures such as the dorsolateral prefrontal, parietal, anterior cingulated, temporal lobe striatum, hippocampus, parahippocampus during Kundalini meditation (Lazar et. al., 2000) that are recruited in attention (Kolb & Whishaw, 2003).

Other imaging studies have been used to detect changes in the cerebral blood flow during different types of meditative practices, which can be associated with different neurophysiological correlates.

A single photoemission computed tomography (SPECT) study with subject performing verbal meditation (Franciscan nuns) and subjects performing visual meditation (Tibetan Buddhists) was conducted. Compared to the baseline, mean verbal and visual meditation scans showed increased blood flow in the prefrontal (Newberg et al., 2001, 2003). In the study with Tibetan Buddhists who reported "becoming one" with the visualized image, the baseline activation patterns revealed a difference in the thalamic laterality index in which meditators showed a significantly greater rightward dominance of thalamic regional cerebral blood flow relative to the control subjects. Meditation (when the meditators reported entering into deepest part of meditative session after one hour) compared to the baseline was related to increased activity in the cingulated gyrus, inferior and orbital frontal cortex, DLPFC, midbrain and thalamus. The midbrain activity can be correlated with alterations in the autonomic functions (Infante et al., 2001, Newberg & Iversen, 2003, Travis & Wallace, 1999, Wenger & Bagchi, 1961). In the study with verbal meditation compared to the baseline, scans during prayer revealed increased blood flow in the prefrontal cortex (7.1%), inferior parietal lobes (6.8%) and inferior frontal lobes (9.0%) along with a strong inverse correlation between the blood flow changes in the prefrontal cortex and in the ipsilateral superior parietal lobe was found. The de-afferentiation of the ipsilateral superior parietal lobule can help generate an altered sense of spatial awareness (d'Aquili & Newberg, 1993 & 2000).

Positron emission tomography (PET) and functional magnetic imaging (fMRI) are beginning to refine the neuroelectric data by suggesting possible neural loci for meditation effects, although how and where such practice may alter the central nervous system have not well been characterized (Cahn & Polich, 2005). Comparisons of Kundalini with Vipassana show differences in fMRI activations across different areas (Lazar et al., 2003).

In spite of variations in the meditation data from a number of neuroimaging studies there is clear indication of certain key areas that are common across these studies. The prefrontal, parietal and cingulated activity has been dominant in most of the studies. The human studies with stimulating cingulated cortex (for longer duration at a rate of sixty stimulations per second) shows occurrence of positive responses. These include, relief from anxiety and tension, feelings of well-being and relaxation. The parietal cortex functions in relating the self of our own physical body to the world outside it besides playing a key role in spatial attention especially processing in the outer visual fields. The prefrontal cortices especially the dorsolateral and the orbitofrontal areas functions as a part of the consortium. Normally, the orbitofrontal areas helps to control impulsive behavior that maybe socially undesirable if carried to extremes. The dorsolateral prefrontal regions have its major interconnections with the parietal lobes. On one side the parietal tends more to foster behaviors that respond to the pull of the outside world, the prefrontal counterpart distances us from the pull of the environment. The prefrontal has major contributions in nourishing out inner-directed, egocentric attitudes. The key element of the dorsolateral prefrontal areas has been found to be higher order executive functions that also include judgement, foresight and exercise of will (Austin, 1999). The roles that these brain areas have been found to play definitely have implications for our quest for understanding brain activity during meditation.

Other Physiological findings related to Meditation

Studies have also tried to compare meditative states with other hypometabolic conditions such as sleep, hypnosis and the torpor of hibernation and it was found that there are several analogies that exist between the physiology of long-term meditators and the above mentioned conditions. The analogies reflect the idea of plasticity of consciousness that exists among these conditions. Studies have shown that there is a rapid decrease in the whole blood and red cell glycolytic rate in the advanced meditators, a process that is very similar to the glycolytic changes seen in lower organisms going into and coming out of hibernation (Young & Taylor, 1998). This is corroborated by studies of individual practitioners who have been meditating for decades and who have gained phenomenal control over typically involuntary bodily processes. The practitioners of Kundalini yoga meditation cause a reduction in the thoracic breathing rate and an increase in the abdominal breathing rate (Arambula et al., 2001). The practitioners of transcendental meditation also experienced lower breath rates during the practice (Travis, 2000). Other personality trait changes include lower anxiety and narcoticism due to meditation (Aftanas & Golosheikin, 2003). Tibetan Buddhist monks studied in their natural environment in a Himalayan monastery practicing G Tum-mo yoga have been shown to first enter into a state of quiet meditation after which they are able to generate such body heat that can dry wet sheets on their back in freezing weather. Yogis in deep bodily rest, lowering their body metabolism while meditating are able to remain in small underground pits under naturalistic conditions and in airtight boxes in laboratory conditions. Researches have also observed significant effect on body's hormonal responses (Infante et al., 2001) and immune functions (Davidson et al. 2002) due to regular practice of meditation.

Cognitive Changes

There has also been a recent interest in identifying behavioral and cognitive changes immediately after meditation (short-term or transient changes) and long-term changes due to meditation (Carter et al., 2005). Two phenomena that have been used to study consciousness include binocular rivalry and motion induced blindness (Bonneh et al., 2001). In a study with Tibetan meditators, a significant portion of meditators showed large increases in the durations of perceptual dominance after one-point meditation compared with compassion meditation as well as controls (Carter et al., 2005). In addition, the mean disappearance duration in the motion induced blindness task was significantly higher for meditators compared to control subjects. It has been reported that one very experienced meditator can voluntarily maintain motion induced blindness for as long as 723 seconds!

Effect of Sahaja Yoga meditation was observed in a study done on 3 groups of epileptic patients. The first group practiced meditation twice a day for 6 months; the second group practiced postural exercises mimicking the meditation for the same duration and the third group was the control group who did not receive any meditation instructions. Sahaja Yoga emphasizes on witnessing the thoughts that come to one's mind without flowing deeper into it while sitting in a quiet well illuminated room. With gradual practice the participants reported to be into a state of "thoughtless awareness". Auditory Evoked Potential (AEP) and Middle Latency Potential (MLR) were measured prior to meditation intervention, three months and six months later. No AEP effects were obtained but the meditation group demonstrated an increase in MLR Na-Pa amplitudes at six months interval. An improvement in Visual contrast sensitivity at all spatial frequencies provided evidence that Sahaja Yoga meditation made the individuals more responsive to specific stimuli. These findings indicate beneficial effects of meditation (Panjwani et al., 2000). Similar studies with Qi-gong meditation showed that ABR waves increased whereas MLR Na and Pa amplitudes decreased 50-73% during Qi-gong meditation relative to before and after conditions (Lou et al., 1990). It has also been shown that critical flicker fusion frequency increases by 11.1% and 14.9% with just 10 and 30 days of yoga training respectively (Vani, et al., 1997). Transcendental meditation practitioners when presented with auditory tones during resting meditation and baseline demonstrated reduced P1, N1, P2, N2 amplitudes, compared to the controls (Wandhofer et al. 1976). It was demonstrated in an oddball paradigm where the standard and the deviant tones were presented with a ratio of 1:15, that there was reduction in the N1 amplitudes when recorded at baseline rest, breath-focused awareness and mantra meditation (Corby et al. 1978). In conjunction with the N1 a positive potential was detected at a latency of approximately 250ms. This positivity is termed as P2-3 and is similar to P200. P2-3 amplitudes were decreased for infrequent tones whereas increased for frequent ones, reasons for which are unknown. Thus the changes in these waveforms of the meditation practitioners when compared to the controls show alterations in the kind of discriminative processing that occurs in the brain due to the practice of meditation. The data is also suggestive of altered perceptual changes in due to indulgence in the practice.

Long-term changes that reflect proactive preparatory processes along with effective allocation of perceptual, cognitive and attentional resources have been observed in long-term practitioners of Transcendental meditation (Travis et al., 2002). EEG waveforms were recorded during two contingent negative variation (CNV) tasks. CNV is an event-related potential, which is observed between the appearance of a warning stimulus and an imperative stimulus that requires a response (Walter et al., 1964). A Simple CNV task is similar to a stop-signal kind of a task where one is required to press button to stop the running stimulus presentation. A Choice CNV task involves comparing pairs of stimuli, such as numbers that are presented serially. The appearance of lower CNV amplitudes during Choice CNV task and higher CNV amplitudes during the Simple CNV task in the group of participants that reported of frequently occurring transcendental experiences implies efficient cognitive processing. These subjects were analyzed by the method of unstructured interviews that revealed fundamentally different descriptions of their self-awareness. The individuals who described themselves in terms of concrete thoughts and actions (lower Consciousness Factor) showed less efficient cortical preparatory responses during CNV tasks. The individuals who described themselves in more abstract and self-referral terms (higher Consciousness factor) showed better cortical responses during the task (Travis et al., 2004). These results imply that experienced meditators waited for the second stimuli more efficiently. The findings are indicative of neurocognitive changes produced by the long-term practice of meditation.

Concluding Remarks

The problem of defining consciousness and explaining the relationship between physical and mental has been the oldest questions of Philosophy. We normally use words such as trance, illumination, enlightenment, *samadhi*, hypnosis, dream and ecstasy, but none of them have clearly been defined. It is also not clear how such experiential states can be studied especially in subjective context associated with a conscious sensation (qualia) termed as the hard problem (Chalmers, 1995). The study of consciousness can be fundamentally subdivided into two approaches – the objective third person approach and the subjective first person approach. Between these two are sometimes added inter-subjective or second person approaches. At present, the cognitive scientists prefer the objective third person approach and are trying to probe the brain mechanisms involved in altered states of consciousness especially meditation using objective techniques. By and large, cognitive scientists and neuroscientists have made a number of working assumptions and have focussed on easy problems (Blackmore, 2004). This is a prudent approach for understanding and furthering our knowledge on consciousness

The cognitive neuroscientific studies reviewed so far in the paper indicate that meditative experiences comprise of phenomenologically and neurophysiologically distinct states. The main inferences that can be drawn from the cognitive neuroscientific studies can be in terms of theta and alpha band activity which increases during the process of meditation and this may alter the neural processes and produce brain and behavioral changes. This increase in theta band activity is typically accompanied by overall slowing and alteration of coherence and gamma effects. While these similarities exist across many EEG and imaging studies, many differences have also been observed between the results from different findings which have to be accounted for and explained. Many factors could contribute to the observed variability (Cahn & Polich, 2005): (a) the word "meditation" differs in terms of the techniques, like Zen, Transcendental meditation, Vipassana meditation, etc. Specific practice may lead to different state and trait changes. (b) Even within a specific meditation tradition, practitioners differ in their degree of meditative practice. In addition their self-selection for participating in scientific studies like EEG, or neuroimaging studies could affect state and especially trait measurement outcomes— for example it is not clear how constitutional variables such as affective valence, personality, and anxiety level affect these measures from empirical studies is unknown. (3) Neurophysiologic markers of meditative states could alter baseline EEG patterns, such that clear within-group meditation effects are obscured—e.g., overall large spectral power would mask pre- vs. post-meditation state changes. (4) It has been established that sleep patterns demonstrated by EEG, change with age. However, it is not clear how EEG measures during meditation are affected by age. (5) Sometimes methodological difficulties limit the generalizability of early recordings and analysis, especially when external stimuli were used to elicit different alpha activity levels.

The method adopted for meditation makes differences in the patterns of brain activity especially in terms of the brain regions that get activated (Lazar et al. 2003, Lehmann et al 2001). One common feature about all the studies is that there are alterations in frontal activity which needs to be further studied. It has been proposed that a necessary prerequisite to the experience of a highly practiced skill is a state of transient hypofrontality that enables a temporary suppression of the analytical, meta-conscious and higher cognitive capabilities of the frontal lobe. The central idea is that the altered states of consciousness are due to transient prefrontal cortex hypo-activity. The underlying assumption is that the proposed hypofrontality is unifying feature of all altered states and the phenomenological uniqueness of each state is the result of differential viability of various frontal circuits (Dietrich 2002). The hypothesis is evidenced from various psychological and neuroscientific studies of meditation, dreaming, endurance running, day-dreaming, hypnosis and various drug-induced states. Consciousness can be conceptualized as a hierarchically organized cognitive function which localizes the most sophisticated layer of consciousness in the zenithal higher order structure to be the prefrontal cortex. The hallmark of altered states of consciousness is the subtle modification of behavioural and cognitive functions that are typically ascribed to prefrontal cortex which needs to be tested empirically. Discrepancies between fMRI and EEG studies are also found. A study is required to identify specific neural substrates based on the putative general differences between meditators and non-meditators.

The process of meditation entails heightened awareness and focused attention while concentrating on a *mantra*, breathing events or any internal or external events. This activates the frontal attentional networks. The neuroimaging studies like PET, fMRI, SPECT etc. show converging evidence of the dorsolateral prefrontal activations. This data appears to contradict the transient hypofrontality hypothesis of altered states of consciousness but the EEG studies with meditation have consistently shown increased alpha and theta activations across the frontal lobe. The alpha and theta waves show the state when the subjects are neither excited nor aroused state. Given that meditation increases attentional focus and awareness, one would expect increased beta activity across the frontal lobe which is detected when the subject is alert and attentive. Putting it precisely, if meditation is considered a method of attaining higher states of consciousness one would expect the neural structures responsible for higher cognitive functions to be more active. The presence of alpha waves in EEG studies with meditation is in severe contrast to the neuroimaging studies that show increased neural activity in the prefrontal cortex. Physiologists have observed that individual neurons in the cerebral cortex are capable of increasing or decreasing their activity from a baseline condition to any other mental state (Raichle, 1998). An accepted view has been that the decreases in neural activity (like increases in frontal alpha rhythm in the case of meditation) reflect the activity of inhibitory interneurons in the cerebral cortex. Since inhibitory processes itself would require energy (Ackerman et al. 1984, Batini et al. 1984, Biral et al. 1984), it would be difficult to distinguish inhibitory from excitatory neural activity based on blood flow and metabolic changes. This is because total increase in the inhibitory activity is just as likely to increase the blood flow as an increase in excitatory activity. Thus, the inhibition of the frontal areas as exemplified by the EEG studies can be accompanied by increases in oxygen consumption and blood flow in these areas during meditation. This also elucidates the significance of EEG studies and temporal changes in understanding the process of meditation.

The decreased frontal activity is also suggestive of reduced metabolic activity. Phenomenologically also, meditators report a state that is consistent with reduced frontal function such as sense of timelessness, denial of self, little sensitivity to emotional stimulation, sensation of unity and abstract thinking. The desynchronized activity of beta waves reflects differential activations of neurons, overlapping circuits or modules resulting in overall noisy signal. The neuronal synchrony that is reflected by alpha activity indicates that large number of neurons fire in a harmonious fashion. As a result, more amount of research is required to resolve the observed discrepancies among EEG and the neuroimaging studies that exist presently.

Attempts have been made to explore different altered states of consciousness including meditation using four phenomenological dimensions, namely, activation, awareness span, self-awareness and sensory dynamics (Vaitl et. al., 2005). It has been pointed out some altered states like meditation and hypnosis pose problems in classifying altered states of consciousness in terms of these four dimensions. It is instructive to note that these four dimensions differ for different methods of meditation making it difficult to come up with similarities in terms of specific dimensions or variables. A future research which would require a collaborative effort to use a stronger methodology and study the above mentioned dimensions to compare various types of meditation can help point out the neurocognitive substrates that mark meditational state of consciousness. Moreover, inferences drawn from our present understanding of the meditation can help us identify what one needs to look for in these studies. Further longitudinal studies which are scarce at the moment, will add to out knowledge about the process of meditation.

References

Ackerman, R. F., Finch, D. M., Babb, T. L.m & Engel, J. (1984). Increased glucose metabolism during long-duration recurrent inhibition of hippocampal cells. *Journal of Neuroscience*, *4*, 251-264.

Aftanas, L. I. & Golocheikine, S. A. (2002). Non-linear dynamic complexity of the human eeg during meditation. *Neuroscience Letters*, *330*, 143-146.

Aftanas, L. I., & Golocheikine, S. A. (2003). Changes in cortical activity in altered states of consciousness: The study of meditation by high-resolution EEG. *Human Physiology, 29*, 143-151.

Albuquerque, E. X., Rash, J. E., Myer, R. F. & Satterfield, J. R. (1976). An leectrophysiological and morphological study of the neuromuscular junction in patients with myasthenia gravis. *Experimental Neurology, 51*, 536-563.

Anand, B. K., Chhina, G. S., & Singh, B. (1961). Some aspects of electroencephalographic studies in yogis. *Electroencephalography and Clinical Neurophysiology, 13*, 452-456.

Arambula, P., Peper, E., Kawakami, M. & Gibney, K. H. (2001). The physiological correlates of Kundalini Yoga meditation: A study of a yoga master. *Applied Psychophysiology and Biofeedback, 26*, 147-152.

Austin, J. (1999). *Zen and the Brain*. MIT Press.

Baitini, C., Benedetti, F., Buisseret-Delmas, C., Montarolo,P. G. & Strata, P. (1984). Metabolic activity of intracellular neucleiin the rat: effects of inferior olive inactivation. *Experimental Brain Research, 54*, 259-265.

Banquet, J. P. (1973). Spectral analysis of the EEG in meditation. *Electroencephalography and Clinical Neurophysiology, 35*, 143-151.

Berger, H. (1929). Uber das elektrenkephalogramm das menschen. *Archiv fur Psychiatrie, 87*, 527-570.

Biral, G., Cavazutti, M., Poro, C., Ferrari, R., Corazza, R. (1984). [14C] Deoxyglucose uptake of the rat visual centers under monocular optokinetic stimulation. *Behavioral Brain Research, 11*, 271-275.

Blackmore, S. (2004). *Consciousness: An Introduction*. Oxford University Press.

Bonneh, Y., Copperman, A., & Sagi, D. (2001). Motion induced blindness in normal observers. *Nature, 411*, 798-801.

Cacioppo, J. T., Tassinary, L.G., & Berntson, G. G., (2000). *Handbook of Psychophysiology*. Cambridge University Press.

Cahn, B.R. & Polich, J. (2005) Meditation States and Traits: EEG, ERP and Neuroimaging Studies. *Psychological Bulletin, 132*, 180-211.

Carter, O.L., Presti, D.E., Callistemon, C., Ungerer, Liu, G.B., & Pettigrew, J. (2005). Meditation alters perceptual rivalry in tibetan buddhist monks. *Current Biology, 15*, 412-413.

Chalmers, D. J. (1995). Facing upto the problem of consciousness. *Journal of Consciousness Studies, 3*, 200-219.

Corby, J. C., Roth, W. T., Zarcone, V. P. & Kopell, B. S.(1978). Psychophysiological correlates of the practice of tantric yoga meditation. *Archives of General Psychiatry, 35*, 571-577.

D'Aquili & Newberg, A. (1993). Religious and mystical states: a neuropsychological model. *Zygon, 28*, 177-200.

D'Aquili & Newberg, A. (2000). The neuropsychology of aesthetic, spiritual and mystical states. *Zygon, 35*, 39-51.

Davidson J., Zinn, J. K., Schumacker, J., Rosenkranz, M., Muller, D., Santorelli, S. F., Urbanowski, F., Harrington, A., Bonus, K., Sheridan, J. F. (2002). Alterations in brain and immune function produced by mindfulness meditation. *Psychosomatic medicine, 65*, 564-570.

Deepak, K. K., Neurophysiological mechanisms of induction of meditation: A hypothetico-deductive approach (2002). *Indian Journal of Physiological Psychology, 46*, 136-158

Dietrich, A. (2002) Functional Neuroanatomy of altered states of consciousness: The transient hypofrontality hypothesis. *Consciousness and Cognition, 12*, 231-256.

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience*, 18, 193-222.

Fenwick, P. B. (1987). Meditation and the EEG. In M. A. West (Ed.), *The psychology of meditation* (pp. 104-117), New York, NY: Claredon Press.

Fenwick, P. B., Donaldson, S., Gillis, L., Bushman, J., Fenton, G. W., Perry, I., et al. (1977). Metabolic and EEG changes during transcendental meditation: an explanation. *Biological Psychology, 5*, 101-118.

Geschwind, N. (1965). The organization of language and the brain. *Science* 170, 940-944.

Goldman, R. I., Stern, J. M., Engel, J., Jr., & Cohen, M. S. (2002). Simultaneous EEG and fMRI of the alpha rhythm. *Neuroreport, 13*, 2487-2492.

Hillyard, S. A., & Anllo-Vento, L. (1998). Event-related brain potentials in the study of visual selective attention. *Proceedings of National Academy of Sciences USA, 95*, 781-787.

Infante, J. R., Avisbal, M. T., Pinel, P., Vallejo, J. A., Peran, F., Gonzalez, F., Contreras, P., Pacheco, C., Roldan, A., Letre, J. M. (2001). Catecholamine levels in practitioners of the transcendental meditation technique. *Psychology and behavior, 72*, 141-146.

Jasper, H. H. (1958). The ten-twenty electrode system of the International Federation. *Electroencephalography and Clinical Neurophysiology*, 10, 371-375.

Kolb, B. & Whishaw, I. Q. (2003). *Fundamentals of human neuropsychology.* Worth publishers, New York.

Kosslyn, S. M. Thompson, W. L., Costantini-Ferrando, M.F., Alpert, N.M. & Spiegel, D. (2000). Hypnotic visual illusion alters color processing in the brain. *American Journal of Psychiatry, 157*, 1279-84.

Lane, R. D., & Nadel, L. (2000). *Cognitive Neuroscience of Emotion. Series* in Affective Science. Oxford: Oxford University Press.

Lazar, S. W. Bush, G., Gollub, R. L., Fricchione, G. L., Khalsa, G., Benson, H. (2000). Functional brain maping of the relaxation response and meditation. *Neuroreport, 1581-1585.*

Lazar, S. W., Rosman, I. S., Vangel, M., Rao, V., Dusek, H., Benson, H., et al. (2003). *Functional brain imaging of mindfulness and mantra-based meditation*. Paper presented at the Society for Neuroscience, New Orleans, LA.

Lehmann, D., Faber, P.L., Achermann, P., Jeanmonod, D., Gianotti, R.R., & Pizzagalli. (2001). Brain sources of EEG gamma frequency during volitionally meditation-induced, altered states of consciousness, and experience of self. *Psychiatry Research, 108*, 111-121.

Lou, H. C., Kjaer, T. W., Friberg, L., Wildschiodtz, G., Holm, S., & Nowak, M. (1999). A ^{15}O-H_2O PET study of meditation and the resting state of normal consciousness. *Human Brain Mapping, 7*, 98-105.

Luck, S. J., Chelazzi, L., Hillyard, S. A., & Desimone, R. (1997). Mechanisms of spatial selective attention in areas V1, V2 and V4 of macaque visual cortex. *Journal of Neurophysiology, 77*, 24-42.

Lutz, A., Greischar, L.L., Rawlings, N.B., Richard, M. & Davidson, R.J. (2004). Long-term meditators self-induce high amplitude gamma synchrony during mental practice. *Proceedings of National Academy of Science* U.S.A, 16369-16373.

Maquet, P., Faymonville, M. E., Degueldre, C., Delfiore, G, Franck, G., Luxen, A. & Lamy, M. (1999). Functional neuroanatomy of hypnotic state. *Biological Psychiatry, 45*, 327-333.

Murthy, P. J., Gangadhar, B. N., Janakiramaiah, N., & Subbakrishna, D. K. (1998). P300 amplitude and antidepressant response to Sudarshan Kriya Yoga (SKY). *Journal of Affective Disorders, 50*, 45-48.

Newberg, A., Alavi, A., Baime, M., Pourdehnad, M., Santanna, J., & d'Aquili, E. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: A preliminary SPECT study. *Psychiatry Research, 106*, 113-122.

Newberg, A., Pourdehnad, M., Alavi, A., & d'Aquili, E. G. (2003). Cerebral blood flow during meditative prayer: Preliminary findings and methodological issues. *Perceptual and Motor Skills, 97*, 625-630.

Newberg, A., & Iversen, J. (2003). The neural basis of the complex mental task of meditation: Neurotransmitter and neurochemical considerations. *Medical Hypotheses, 61*, 282-291.

Pagano, R. R., Rose, R. M., Stivers, R. M. Warrenburg, S. (1976). Sleep during transcendental meditation. *Science, 191*, 308-310.

Panjwani, U., Selvamurthy, W., Singh, S. H., Gupta, H. L., Mukhopadhyay, S., & Thakur, L. (2000). Effect of Sahaja Yoga meditation on auditory evoked potentials (AEP) and visual contrast sensitivity (VCS) in epileptics. *Applied Psychophysiology and Biofeedback, 25*, 1-12.

Rainville, P., Hofbauer, R. K., Paus, T., Duncan, G. S., Bushnell, M. C. & Price, D. D. (1999). Cerebral mechanism of hypnotic induction and suggestion. *Journal of Cognitive Neuroscience, 11*, 110-125.

Rechtschaffen, A. & Monroe, L. J. (1969). Laboratory studies of insomnia. In A. Kales Ed. *Sleep: physiology and pathology*, Philadelphia: Lippincott.

Satprakashananda, S. (2004). *Meditation: its process, practice and culmination*. Sri Ramakrishna Math Printing Press.

Schwartz, G. E., & Shapiro, D. (1978). *Consciousness and self-regulation, Advances in research and theory, Volume 2*. New York: Plenum Press.

Tart, C. T. (Eds.). (1969). *Altered States of Consciousness: A Book of Readings*. New York: John Wiley & Sons.

Taylor, J.G. (2002) Paying attention to Consciousness. *Trends in Cognitive Sciences, 6*, 206-210.

Travis, F., Tecce, J., Arenander, A., & Wallace, R. K. (2002). Patterns of EEG coherence, power, and contingent negative variation characterize the integration of transcendental and waking states. *Biological Psychology, 61*, 293-319.

Travis, F., Tecce, J. J., & Guttman, J. (2000). Cortical plasticity, contingent negative variation, and transcendent experiences during practice of the Transcendental Meditation technique. *Biological Psychology, 55*, 41-55.

Travis, F. & Wallace, R. K. (1999). Autonomic and EEG patterns during eyes closed rest and transcendental meditation (TM) practice: the basis for a neural model of TM practice. *Consciousness and cognition, 8*, 302-318.

Vaitl, D., Birbaumer, N., Gruzelier, J., Jamieson, G.A., Kotchoubey, B., Kubler, A., Lehmann, D., Miltner, W.H.R., ott, U., Putz, P., Sammer, G., Strauch, I., Strehl, U., & Wackermann, J. (2005). Psychobiology of altered states of consciousness. *Psychological Bulletin, 131*, 98-127.

Vani, P. R., Nagarathna, R., Nagendra, H. R. & Telles, S. (1997). Progressive increase in critical flicker fusion frequency following yoga training. *Indian Journal of physiological pharmacology, 41*, 71-74.

Varela, F., Lachaux, J., P., Rodriguez, E. &Martinerie, J. (2001). The brainweb: phase synchronization and large scale integration. *Neuroscience, 2*, 220-230.

Walter, W. J., Cooper, R., Aldridge, V. J., McCallum, W. C. & Winter, A., L. (1964). Contingent negative variation. An electric sign of sensorimotor association and expectancy in the human brain. *Nature, 203*, 308-384.

Wandhofer, A., Kobal, G & Plattig, K. H. (1976). Latenzverkurzung menschlicher audotorisch evozierter hirnpotentiale bei transzendentaler meditation (German). *EEG-EMG Zeitschrift fur elektroenzephalographie, elektromyographie und verwandte gebiete*, *7*, 99-103.

Wenger, M. A. & Bagchi, B. K. (1961). Studies of autonomic functions in practitioners of yoga in India. *Behavioral Science*, *6*, 312-323.

Wilson, R. A., & Keil, F. C. (1999). *The MIT Encyclopedia of the Cognitive Sciences* Massachussets, MIT Press.

Young, J. D., & Taylor, E. (1998). Meditation as a voluntary hypometabolic state of biological activation. *News in Physiological Sciences, 13*, 149-153.

Attention, Awareness, and Knowledge: Implications of Change Blindness

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Introduction

People are poor in detecting change, even if the change is large and observers are expecting the change. This inability to detect change is termed Change Blindness (CB). Whenever a change occurs there is a motion transient associated with the change. Since in natural conditions change is always associated with this motion transient due to change, observers believe that they will be able to detect any change occurring in their near surroundings. CB occurs when this motion due to change is not perceived by the observer. To study this phenomenon, CB is induced in experimental conditions by masking the motion due to change.

In contrast to this difficulty, some studies from scene perception have argued for existence of detailed representations based on good performances. Conceptual short-term memory was proposed by Potter (1993) who described it as consisting of fleeting conceptual representations that are generated early in perceptual processing and can be regarded as conceptually structured as very short-term memory (VSTM), tightly linked to long term memory (LTM). Potter argued that pictures could be identified in very brief period of time (100m sec) maintained in conceptual short-term store for few hundred milliseconds while it gets consolidated in memory. Although this representation is not susceptible to masking, conceptual masking can disrupt its consolidation by new visual information.

Studies with CB have been arguing against this view of detailed representations of visual scenes. Simons and Levin (1997) suggest that current-state buffer may not contain as detailed information as suggested. Grimes (1996), in his experiment, tracked observers' eye movements while they viewed scenes for 10 seconds, in a change detection experiment. Scenes were altered during eye movements, and a single object was changed either in size, color or location or they could disappear. Observers were surprisingly blind to changes and detection accuracy was only 33%. In a study by O'Regan, Rensink and Clark (1996), they tried to find whether scene changes producing transients were likely to be detected, and whether unrelated transients occurring simultaneously will affect detection. Their original and modified scenes appeared alternately every 6.2 seconds. In 'mud splash' condition, 6 small ovals or squares were spattered on the pictures and did not obscure the change in scenes. Changes were made in color, position or presence of objects. Changes without mud splashes were detected immediately but with mud splashes, several transitions were needed. Also, changes to objects of central interest were detected faster than changes to objects of marginal interest.

Mack & Rock (1998) proposed the concept of "Inattentional blindness" to explain failure of change detection. Their hypothesis is that we do not consciously perceive objects to which we have not attended. In their experiment, observers were briefly presented a cross, whose vertical and horizontal component differed slightly in length. Observers were asked to judge whether the vertical or horizontal component of it is longer. In one of the trials an irrelevant stimulus was flashed in one of the quadrants formed by the cross. After the trial, observers were asked if they saw anything out of ordinary. Observers failed to report the irrelevant stimulus when they were not aware that such stimulus might appear, however normally irrelevant stimulus was easily visible. Mack & Rock (1998) argued that in the absence of attention, the irrelevant stimuli never rose to the level of conscious perception.

The inattentional blindness argument is used to explain failure of change detection in Grime's (1996) experiment. Inattentional blindness argues that the changes are not seen because the changed object was not attended and thus not consciously perceived. However, inattentional blindness fails to explain convincingly results of Simons and Levin (1997) or Rensink et al (1996) experiments in which stimuli is presented for very long time. In their experiments observer surely attended to the object and yet not detected changes to them.

Observers fail in tasks which involves making decisions utilizing information from representation. Sperling (1960) in his experiment asked the observer to report all letters which were briefly flashed in a matrix of four columns and three rows. The observers were 25 -30% accurate. However, when they were asked to recall from a single row which was cued after the stimulus offset, their performance improved. In Sperling's experiment participants responded after the stimulus has been removed but information about the stimulus was still available in iconic memory. In experiments by Mack & Rock observers where asked to report if they saw anything unusual after the trial. In experiments by Simons and Levin observer had to compare the current speaker with the previous one. In all these experiments, unattended stimuli cannot be accurately reported after the stimulus offset. Wolfe (1999) proposed two possible explanations for this phenomenon. First, as suggested by Inattentional blindness, stimulus may not be seen or if they have been seen they are not remembered, i.e. Inattentional Amnesia. The Inattentional amnesia hypothesis proposes that we perceive information (visual stuff) at all the locations of visual field under normal circumstances. At the current attended location, interaction with other memory processes may occur, resulting in object recognition and transfer into memory. Visual representations may be different while they are attended. The current conscious visual representation is composed of "visual stuff" and effect of attention. The visual representation is not remembered, it exists only in present tense. When visual stimulus is removed, its representation is lost. When attention is allocated to new object trace of previously attended object is lost. According to this hypothesis, if "visual stuff" is unattended, it will be seen but instantly forgotten.

Explanations for Change Blindness

Different views have been proposed to explain the cause for CB. In the absence of motion transients, change can be successfully detected if the object to be changed is represented in a detailed fashion and observer is able to compare the old information with the new information. Since CB is very common phenomena, it leads to the interpretation that the nature of visual representation might not be very detailed or the problem is at the level of encoding and retrieval. Some of the possible explanations of CB (Simons, 2000) are -:

1. *Overwriting* - Overwriting models propose that CB is due to the overwriting of old information by the blank or new information. When the representation of previous stimulus is overwritten, only abstract information about the previous stimulus is retained. Successful change detection can occur only if the information about changed object is the information that is retained as abstract information in VSTM.

2. *First Impressions* – This model argues that CB arises when the original scene is encoded successfully but the changed scene is not stored. The visual system actively updates information and tries to find the meaning of the stimulus. Small changes to scenes fail to be represented if the meaning of the stimulus is not affected by the change.

3. *Nothing is stored*- This model is based on the view that nothing is stored and the world itself acts as a memory store. Only the information that is abstracted from the

stimulus is retained and successful change detection occurs if the information about the object to be changed is stored as abstracted information.

4. *Everything is stored but nothing is compared-* This model proposes that representation of both original and modified stimulus is stored but CB occurs because people do not realize that there is difference in the information in the two representations. Comparison occurs only when there is change in the semantic content of the stimulus.

5. *Feature combination-* This model is argues that CB occurs because the representation of pre-change and post-change stimulus is not kept separate but integrated together. Some information is retained from first stimulus, when second stimulus is presented features of earlier representations are combined with features of new representations. Change is detected successfully when these two representations have information which when integrated leads to semantic inconsistency.

However, evidence has been found which suggest that CB might arise due to absence of conscious representation of change; it is possible that implicit representation of change is there even if observer is not aware of it. All these explanations fit partially with the results of CB studies. Systematic study of all possibilities has not been done, and hence conclusion in the favor of only one of the explanations is not possible at the present time.

Is Attention Necessary for Change Detection?

Studies on CB make a strong claim that attention is necessary to perceive change. Change cannot be detected unless the motion due to change attracts attention to the location of change. In experimental conditions, when this motion due to change is masked, change is detected only when the object to be changed is in focus of attention. Rensink et al (1997) argued that attention is required to perceive change and in the absence of motion signals it is guided on the basis of level of interest. It was proposed that it is possible that allocation of attention causes the relevant information to form object files or let them enter into a durable store so that comparisons can be made later. It was found in their experiment that change blindness was reduced for items that were considered "interesting" or were cued.

Irwin (1996) proposed an *Object-file theory of transsaccadic memory,* which emphasizes role of attention as feature binder in representations. This theory explains perception of objects using four levels representation: Feature maps, a master map of locations, temporary object representations called object files and an abstract long-term recognition network. According to this theory, when a scene is presented, features in the scenes are represented in feature map that registers the sensory features like color and shape in the scene. Master map of location contains the spatial location information of each feature. Attention is required to combine separate feature of scene and to obtain precise location of features to produce an integrated object file. Limited number of object files (three- four) can be maintained across saccades because of short-term memory limitations. These object files activate information stored in long-term information network so that long-term memory representations can also occur across saccades. According to Object-file theory of transsaccadic memory, we perceive changes that occurred in scene during saccades only when one of the few objects encoded in transsaccadic memory is changed. The stability is assumed by perceptual system if changes occur to objects that are not encoded in transsaccadic memory.

Rensink (2000) proposed *Coherence theory* which is similar to object-file theory in emphasizing role of attention in building coherent representations. The important aspects of coherence-theory are-

1. Prior to focused attention, early processing occurs which is low level, rapid and carried out in parallel across visual field. This early processing results in proto-objects that can be complex and describing several aspects of scene structure. However, they have limited spatial and temporal coherence and can be replaced easily by new information.

2. Focused attention selects these constantly generating proto-objects, which form a part of coherence field representing an individual object. These coherence fields are formed by feedback between proto-objects and mid-level nexus. Coherence so formed maintains continuity across brief interruptions (e.g. saccades).

3. Attention is released when this feedback loop is broken. Coherence of field is lost and representation of the object converts back to proto-objects.

According to this theory when scene is initially processed only its gist, layout and abstract identities are remembered.

Attention is Necessary but not Sufficient

While there is one view that strongly supports the claim that attention is necessary for explicit reporting of change, another view proposes that attention might not be the only critical factor in detecting change. Levin and Simons (1997) in their experiment showed that change detection was poor even when the changed object was attended. Forty observers were shown a movie clip in which a single actor was performing some actions. When actor was switched across the camera positions, observers failed to notice the change. When observers were warned about the change, performance was better. It was concluded that object features do not integrate automatically to form different views of the scene.

Results of experiment by Mack and Rock (1998) were interpreted by Braun (2001) as an argument to support that attention is not sufficient to detect change. The failure of change detection in their experiment was due to lack of expectation rather than attention. Rensink et al (1997) found in their study that changes to objects of central interest are easier to detect than changes to object of marginal interest. This faster detection of change to object of interest could be due to the fact that we are expecting change to significant objects of the stimulus. Simons et al (1998) found that people do not notice even when person to which they were talking is changed. This failure to detect change could be because of our expectation of stable world. We do not expect people to suddenly change into someone else. These studies on inattentional blindness and CB suggest that blindness is more from observer's inability to anticipate the stimulus than from lack of attention. Thus, it can be concluded that attending to an object is necessary but not sufficient for change detection.

Knowledge and CB

CB is closely associated with the representations of stimuli and the information that is available from these representations. CB studies have been used to make inferences about the nature of representations and knowledge about the world provided by these representations. While studies on scene perception claim that though a single glimpse corresponding to an eye fixation is sufficient for comprehending the gist of the scene (Potter, 1993), and the detailed representation features of the scene are built in by discrete views of the parts of the scene. Experiments on iconic memory (Sperling, 1960) indicate that representation are fleeting and decay rapidly. CB studies give support to two different views about representations. *First*, representations are not detailed and only limited information can be stored and compared, the information that is not attended is overwritten by new information. *Second*, the representations are sufficiently detailed and can give information about change even when retrieval cues appear after change.

Support for the first view, which argues that visual representation if detailed cannot be coherent and if it is coherent, it cannot be highly detailed, comes from Rensink (1997). Rensink (2000) proposed that there is a possibility that instead of static all purpose representation a dynamic representation is used which is highly sensitive to observer's expectations. He proposed the *triadic architecture* (2000), which has three independent systems, early processing, object system and setting system. Early processing is a low level system that generates highly detailed volatile structures continuously. Object system is a coherent object representation that is formed by limited capacity attentional system, it stabilizes the structures created by early processing. Setting system is a limited capacity non-attentional system that guides the attention. This system may be based on gist and layout of the items. In Triadic architecture, rapid and constant generation of representation of proto objects forms the basis of rapid determination of scene gist.

The evidence for second view comes from a study of Hollingworth and Henderson (2001). In their study change in objects were made during saccade to another object after the target was attended. The change was either in the form of type change (where object is replaced by another object of different basic level category) or token change (where object is replaced by another object of same basic level category). Participants were able to detect changes when the target was attended but was not within the focus of attention when the change occurred. Using forced choice method observers correctly identified change (type or token change) during a subsequent long-term memory task. These data suggest that visual memory for previously attended object in natural scenes is relatively detailed. Hollingworth (2003) explored whether encoding, retrieval and comparison failures are the major causes of change blindness. He argued that encoding failure occurs when changing object is not attended before the change. Either attention was not allocated to the target object or though some information is encoded, it is not sufficient to detect change because of the limitations of viewing time. Visual transience theories propose that representation of the object decays immediately after attention is withdrawn from them or new visual input overwrites the information in memory. In this experiment, the object either changed in orientation or token (object of one basic category is replaced by object of same category). They found that change detection was higher when target post-cue (cuing the object after change has occurred) limited the number of items to be retrieved and compared. Change detection was high even when target was not attended at the time of change and when verbal memory load minimized the possibility of verbal encoding. These results indicate that visual representations of attended objects accumulate in memory, as the eye and attention are oriented within the scene. It was also emphasized that change blindness arises at least in part due to retrieval and comparison failure.

Landman et al. (2003) also argued for large relative storage capacity. They proposed that representations are detailed (close to six to eight items can be held in memory, compared to four objects proposed by object file theory) and capacity to detect change is high. However, post-cues, that is, cuing after the change occurred, were ineffective, suggesting that the CB could be due to limitations of visual system to process information rather than failure to retrieve and compare information.

CB studies were also used to study effect of familiarity and knowledge in change detection. Earlier studies indicated that change detection in unfamiliar visual stimuli is mediated by sensory persistence and visual short-term memory. It is widely supposed that the information about familiar stimuli is encoded rapidly and automatically and comparable level of encoding is not available for unfamiliar stimuli. Pashler (1988) investigated the role of familiarity in visual change detection arguing that detection of change in familiar object might be purely based on visual codes or on identity information. In the experiment he displayed ten alphanumeric characters were displayed and after a brief offset were presented again at same locations with or without change in a single character. Participants did not show preservation of information except when offset duration was very small (50 ms). Detection of change appeared to depend upon limited capacity visual memory and knowledge about identities and location were not important for change detection. Visual system continuously selects the items to be selected and as a result large changes are not observed to the unattended item. Another study (Beck et al, 2004) investigated whether the knowledge about the probability of particular change to occur increased their chances of being detected. This study showed that participants were more likely to detect probable changes whether or not they processed scenes meaningfully. Changes that are likely to occur in real world are detected more frequently. However, observers are unaware that they detect probable changes more frequently.

Thus CB studies give information that representations have some information about the stimuli, these representations are volatile decaying as soon as attention is withdrawn from them, if there is over-load of information. When there is no immediate demand on attention, these representations are accumulated in memory to form a coherent representation of complete stimulus. Familiarity and knowledge about probability of an object to change affects how these objects are encoded, indicating involvement of LTM in encoding of information.

Change Blindness and Awareness

Usually CB studies involve explicit reporting mechanism to report change under the assumption that only those information that we are aware of will affect the behavioral response. Change is reported explicitly only when it is represented clearly. Attention is necessary for this coherent representation of visual stimuli as it binds the 'object files' together across saccades to form a detailed representation (Treisman, 1988). It is argued that without attention coherent representation cannot exist. Rensink (2000) in his 'Coherence Theory' emphasized the importance of attention in building a coherent representation. Attention is not only important for coherent representations but also for awareness. Attention and awareness are usually associated with each other as attention determines the content of awareness. However, attention and awareness are not synonymous. Attention is responsible for coherent representation and modulation of awareness but it is not sufficient for detection of change (Thornton and Fernandez-Duque 2002). Representation of change can be built without attention, which can be later affected by attention.

Classic work with human amnesic patients and patients with blindsight show that encoding and retrieval can occur even in the absence of explicit awareness. Weiskrantz (1991) discussed various studies with amnesic and blindsight patients, giving support to claim that behaviour is affected by unconscious information. The patients with anterograde amnesia, who cannot remember new events, show learning for motor and other procedural memory tasks. They are good in learning tasks which involve procedural memory because it does not require them to be explicitly aware. Patients with blindsight lose awareness of certain parts of their visual field but retain ability to correctly guess the stimulus property of the object in the region they are unaware of as visual connection of that region is not disconnected. Humans as well as monkeys with blindsight when forced to make a decision about information in blind region, they perform above chance level. These results indicate that although information is available, it does not reach conscious awareness and yet it can affect behaviour. Fernandez-Duque and Thornton (2000) have argued for the existence of sensitivity to change in the absence of awareness and this sensitivity does not rely on redeployment of attention. In their experiment, a distracter appeared at the location opposite to change. When observer was uncertain about change they were asked to guess the location of change. It was found that even in the absence of awareness the performance was above chance in two alternative forced choice localization tasks. They proposed a non-attentional representational system capable of registering change in the absence of awareness. This representational system is outside the reach of attention.

While people can use information of which, they claim they were unaware, people are remarkably wrong in estimating their ability to detect change. Levin et al (2000) found their experiment that people over estimated their capability to detect change. They called this metacognitive error as "Change Blindness Blindness". They explained this error as result of bias, that people think that since they have detected some changes in the past (which were probably accompanied by motion due to change), they will be able to detect changes in future. Another important explanation was that, such a change is implausible to occur in natural conditions. People do not expect objects to appear or disappear suddenly as we rely strongly on spatio-temporal coherence.

Rensink (2004) in his study tried to find if observer could consciously sense that a change is occurring without actually seeing it. In his experiment observers were presented with a flicker sequence in which a real world image alternated with its modified form. Observers were asked to press button first (t1) when they are aware of the change and (t2) if they can see the change. Catch trials were 12.5%. Results indicate "considerable fraction of observers can have abstract mental experience without sensory experience". Rensink (2004) proposed that mindsight may allow exploration of processes that were not possible using conventional techniques. Mindsight may correspond to 'sixth sense' that is believed to warn us of dangerous situation. However, this conclusion about mindsight was strongly criticized by Simon et al (2005), who got similar results in his experiment but explained it in terms of observer being more cautious in reporting change and holding on to the decision unless they are sure of change.

Thus CB studies help in make a very important distinction between role of conscious and unconscious information. Detection of change does not depend on conscious perception of change as information we are not aware of also help in detecting change. While conscious perception is necessary for explicit reporting of change, information we are unaware of show their effect by indirect means.

Conclusion

CB studies have been used successfully to probe involvement of attention, knowledge and awareness when involved in a task like change detection. While it was claimed that attention is necessary for detection of change, it was also emphasized that attention plays an important role in binding features of object in coherent representation. This representation is consolidated if not distracted by task demanding attention. This representation is influenced by long term memory of objects and events as objects that are familiar or are known to be important are processed in detail while rest of information are represented as a gist. Though we rely on awareness to make critical judgments, we are not really aware of our capacities, resulting in wrong estimation of our abilities (CBB).Awareness of the information arise when attention is allocated to it, however, awareness is not necessary for any information to effect behaviour. Unaware information are also available and affect behaviour, however to find proof of such information indirect methods like forced choice are required. Claims have been made about the possibility of existence of mindsight which enables to sense information before actually being aware of it.

References

Aginsky, V., & Tarr, M. J. (2000). How are different properties of a scene encoded in visual memory? *Visual Cognition, 7*, 147-162.

Beck, M.R., Angelone, B.L., & Levin, D.T. (2004). Knowledge about the probability of change affects change detection performance. *Journal of Experimental Psychology: Human Perception and Performance, 30*, 778-791.

Braun, J. (2001). It's great but not necessarily about attention. *Psyche*, 7(6). Retrieved from http://psyche.cs.monash.edu.au/v7/psyche-7-06-braun.html

Coltheart, V. (1999). Perceiving and remembering Brief Visual Stimuli. In V. Coltheart (Ed.), *Fleeting Memories: Cognition of Brief Visual Stimuli*, 1-12, MA: MIT Press.

Fernandez-Duque, D., & Thornton, I. M. (2000). Change detection without awareness: Do explicit reports underestimate the representation of change in visual system? *Visual Cognition, 7*, 323-344.

Grimes, J. (1996). On the failure to detect changes in scenes across saccades. In K Akins (Ed.), *Vancouver Studies in Cognitive Science .Vol. 5. Perception* (pp. 89-110). New York: Oxford University Press.

Henderson, J.M., & Hollingworth, A. (1999). The role of fixation position in detecting scene changes across saccades. *Psychological Science, 10*, 438 - 443.

Hollingworth, A., Williams, C. C., & Henderson, J. M. (2001). To see and remember: Visually specific information is retained in memory from previously attended objects in natural scenes. *Psychonomic Bulletin & Review, 8*, 761-768.

Hollingworth, A., & Henderson, J. M. (2002). Accurate visual memory for previously attended objects in natural scenes. *Journal of Experimental Psychology: Human Perception and Performance, 28*, 113 -136.

Hollingworth, A. (2003). Failures of retrieval and comparison constrain change detection in natural scenes. *Journal of Experimental Psychology: Human Perception and Performance 29*, 273-286.

Hollingworth, A. (2004). Constructing visual representation of natural scenes: The role of short and long term visual memory. *Journal of Experimental Psychology: Human Perception and Performance, 30*, 519-537.

Irwin, D.E. (1996). Integrating information across saccadic eye movements. *Current Directions in Psychological Science, 5*, 94-100.

Intraub, H. (1999). Understanding and remembering briefly glimpsed pictures: implications for visual scanning and memory. In V. Coltheart (Ed.), *Fleeting Memories: Cognition of Brief Visual Stimuli*, MA: MIT Press, 47-70.

Kahneman, D., Treisman, A.M., Gibbs, B.J, (1992). The reviewing of object files: object-specific integration of information. *Cogitive Psychology, 24,* 175-219.

Landman, R., Spekreijse, H., & Lamme, V.A.F. (2003). Large capacity storage of integrated objects before change blindness. *Vision Research, 43,* 149-164.

Levin, D. T., Simons, D. J. (1997). Failure to detect changes to attended objects in motion pictures. *Psychonomic Bulletin and Review, 4,* 501-506.

Levin, D. T., Momen, N., Drivdahl, S. B., & Simons, D. J. (2000). Change blindness blindness: The metacognitive error of overestimating change-detection ability. *Visual Cognition, 7,* 397-412.

Mack, A., & Rock, I. (1998). *Inattentional blindness.* Cambridge, MA: MIT Press.

O'Regan, J.K., Rensink, R.A., & Clark, J.J. (1999). Change blindness as a result of 'mud-splashes.' *Nature* 398,34

O'Regan, J.K., Deubel, H., Clark, J.J., & Rensink, R.A. (2000). Picture changes during blinks: Looking without seeing and seeing without looking. *Visual Cognition.* 7:191-211

O' Regan, J. K. (2003). Change blindness. In L. Nadel (Ed.), Encyclopedia of cognitive science (Vol. 1, pp. 486-490). London: Nature Publishing Group.

Pashler, H. (1988). Familiarity and visual change detection. *Perception and Psychophysics, 44,* 369-378.

Potter, M. C. (1993). Very short-term conceptual memory. *Memory & Cognition, 21,* 156-161.

Rensink, R.A., O'Regan, J.K., & Clark, J.J. (1997). To see or not to see: The need for attention to perceive changes in scenes. *Psychological Science, 8,* 368-373.

Rensink, R. A. (2000a). Seeing, sensing and scrutinizing. *Visual Research, 40,* 1469-1487.

Rensink, R.A., O'Regan, J.K., Clark, J.J., (2000b). On the failure to detect changes in scenes across brief interruptions. *Visual Cognition, 7,* 127- 145.

Rensink, R.A. (2000c). The dynamic representations of the scenes. *Visual Cognition 7,* 17- 42.

Rensink, R. A. (2002). Change Detection. *Annual Review of Psychology, 53,* 245-277.

Rensink, R.A., (2004). Visual sensing without seeing. *Psychological Sciences,* 15, 27-32.

Scholl, B. J. (2000). Attenuated change blindness for exogenously attended items in a flicker paradigm. *Visual Cognition, 7,* 377-396.

Simons, D. J. (1996). In sight, out of mind: When object representations fail. *Psychological Science, 7,* 301-305.

Simons, D. J., & Levin, D. T. (1997). Change blindness. *Trends in Cognitive Science, 1,* 261-267.

Simons, D. J., & Levin, D. T. (1998). Failure to detect changes to people in a real-world interaction. *Psychonomic Bulletin and Review, 5,* 644-649.

Simons, D. J., Franconeri, S. L., & Reimer, R. L. (2000). Change blindness in absence of visual disruption. *Perception, 29,* 1143-1154.

Simons, D. J., & Mitroff, S. R. (2001). The role of expectations in change detection and attentional capture. In L.R. Harris & M. R. M. Jenkin (Eds.), *Vision and Attention*, 189-207, Springer Verlag.

Simons, D. J. (2000). Current approaches to change blindness. *Visual Cognition, 7,* 1-16.

Simons, D. J., Nevarez, G., & Boot, W. R. (2005). Visual sensing is seeing: Why 'mindsight', in hindsight, is blind. *Psychological Sciences, 16(7),* 520-524.

Simons, D. J., & Rensink, R. A. (2005). Change blindness: Past, present and future. *Trends in Cognitive Sciences, 9(1), 16-20.*

Smilek, D. Eastwood, J. D., & Merikle, P. M. (2000). Does unattended information facilitate change detection? *Journal of Experimental Psychology: Human Perception and Performance, 26, 480*-487.

Sperling, G (1960). The information available in brief visual representations. *Psychological Monographs, 74,* 1-29.

Thornton, I.M. & Fernandez-Duque, D. (2000). Converging evidence for detection of change without awareness. *Progress in Brain Research, 140,* 99-118.

Treisman, A. M., & Gelade, G (1980). A feature-integration theory of attention. *Cognitive Psychology, 12,* 97-136.

Weiskrantz, L. (1991). Disconnected awareness for detecting, processing, and remembering in neurological patients. *Journal of Royal Society of Medicine, 84,* 466-470.

Wolfe, J. M. (1999). Inattentional amnesia. In V. Coltheart (Ed.), *Fleeting Memories: Cognition of brief visual stimuli,* 71-94. Cambridge, MA: MIT Press.

Actions, Knowledge and Consciousness

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Introduction

The one neglected, or rather taken for granted, characteristic of human behavior is the role of action in cognition and consciousness. Recent evidence from cognitive science shows that action plays an epistemic (i.e. knowledge) role in some cognitive tasks (Kirsh & Maglio, 1994; Wexler et al, 1998; Wexler & van Boxtel, 2005). In this view, actions provide *knowledge*. Extending this possibility, we ask the question: What role could action play in *consciousness*? Would it be possible to establish *action* as a link between *knowledge of the world* and *consciousness?*

The paper is organized into three sections. The first section presents the basic frameworks used to discuss the relationships between perception and action. Milner and Goodale's work on the "*what*" and the "*how*" system as well as Alva Noe's position on perceptual experience and action are discussed. The next section discusses the role actions play in acquiring knowledge. We consider actions in general, and then the role of epistemic actions in cognition. Finally we discuss the relationship between action and consciousness. We end with a call for adopting dynamic approaches to studying the relationships between action and perceptual experience.

Action and Perception

Traditionally, actions are viewed as a response to stimulus from the external world. However, the response is not considered to be direct. The stimulation from the world is considered to pass through a perception and a cognition phase before an appropriate action is taken. Perception creates representations that get passed onto cognition. The *agent (*modules that are involved in higher cognitive processes like decision-making) then calculates the best course of action based on goals and this is achieved by manipulating representations and this is achieved through mental processes (computations). After these manipulations, a decision is taken about the course of action and appropriate commands are sent to the action system. The action system then triggers behavior. This is a standard information (computational) processing view. According to this standard view, action would be an output of a cognitive process (see Figure 1a). Hurley (1998) calls this the classical sandwich view of perception and action.

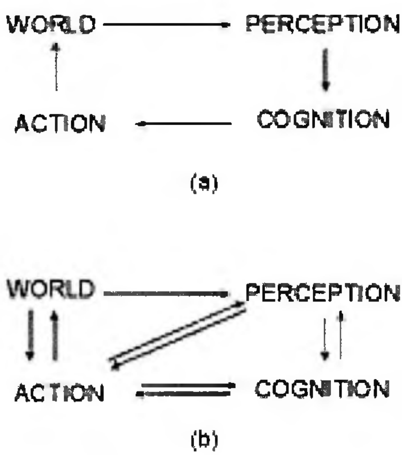

Figure 1: (a) Classical view (b) Dynamical view

In contrast to this view stands the dynamical/interactionist view. Here all the components of mind and behavior are coupled strongly. The components are action, perception, cognition and world. Perception, action and cognition form a coupled loop with interactions between them (see Figure 1b). The loops provide cognition with messy, partial information. According to dynamical approach, there is no need of detailed internal representation. The world would be its own best model. Historically many psychologists and philosophers have emphasized the interdependence between action and perception. For example, Gibson (1979) in his ecological approach to perception has argued for the important role of action in perceiving optical information. Optic flow patterns generated when the observer moves actively or passively in an environment is correlated with information regarding various aspects of objects. This information is not available when the observer is stationary. Here, the action (motion of the observer) is intertwined with optical information about objects (perceptual knowledge) arguing for the active nature of perception.

There are various ways in which the relationship between action and perception is characterized based on empirical evidence from behavioural and neuropsychological studies. In vision, models have been proposed based on the active nature of perception (Ballard et al., 1997). In the domain of speech, Liberman and his colleagues have proposed the motor theory of perception (Liberman & Whalen, 2000). A theory of action, common coding theory, has been proposed in which actions are coded based on the effects they have on perception (Hommel et al., 2002). Recent neurophysiological evidence on "mirror" neurons (Gallese et al., 1996) also supports models that propose a closer link between perception and action.

One influential view on the systems governing action and perception and the way these functions are organized comes from the work of Milner and Goodale (1998). Milner and Goodale (1998) have found that there are two major pathways in the visual system, ventral stream and dorsal stream. The ventral stream forms the percept-cognition pathway independent of visuomotor pathway, dorsal stream. The former is for constructing representations and manipulations of it, whereas the latter is for direct vision-action stream. One set of evidence for their view comes from neuropsychological studies of patients with specific cognitive disorders. In support of the two system view, Milner and Goodale (1998) discuss a patient named D.F. who developed visual form agnosia, a disorder where the patient loses the percept of the object. The damage was seen in ventrolateral region of occipital lobe (ventral stream). Interestingly, the person is able to perfectly grasp objects which he says he does not see. The motor movements are perfectly aligned and oriented towards the objects. This dissociation, Milner and Goodale (1992) propose, is because of separate neural pathways for transforming incoming visual information for action and perception. Though you don't have perceptual knowledge of the object, you are able to act upon it. This they say is possible because the spatial/motion information from the primary visual pathway goes to action module directly without being mediated by visual object representations. This visuomotor pathway (dorsal stream) is what they call the "*how*" system. Based on an evolutionary point of view, they propose that vision was developed to guide movements and later evolved to become an independent representational system, where you have a percept of the object. The transformation from visual information to direct output – action, through visuomotor modules, are not available to our consciousness as the output of cognitive processes are available to us as a percept.

An important aspect to consider actions is the ways in which they are characterized. Merleau-Ponty (1962) makes a distinction in actions by talking of intentional motor actions and non-intentional reflex action which constitute different forms of actions. An example of the two forms of action would be 'pointing' and 'grasping'. For him 'pointing' to an object differs from 'grasping' an object. This distinction is made clear by considering a patient, Schneider, who was unable to perform any abstract irrelevant actions like moving arms and or legs, or opening and closing fingers, with eyes closed. However he was able to do routine actions like taking handkerchief from pocket and blowing his nose and lighting a lamp using match stick with eyes closed and with precision. However, he was unable to describe abstract actions like the position of his body or head and also to point to a body part. On contrary that was not the case with concrete actions. For example, he reacted accurately and moves his hand to the point on his body where a mosquito was sitting. Given this case as an example Merleau-Ponty makes a distinction between 'pointing' and 'grasping' and call traditional cognitive scientists to consider the implications of different forms of action while studying actions. One possible mapping is to link 'pointing' to what-system and 'grasping' to how-system. Given these different views on the relationship between perception and action it is important explore how actions in acquiring knowledge.

Knowledge and Actions

Goodale and Humphrey (1998) talk of two forms of knowledge of objects in the world. When we see an apple, we recognize it as an apple. This recognition happens by accessing our perceptual representation from long-term memory. The percept formed now with the given input is tallied with the representation of the object we have and then the final decision is taken about the identity of the object. This is perceptual plus cognitive process, by which identification happens. In contrast, the knowledge of the object also includes its relation in the world with other objects spatially and temporally. This knowledge, they argue, is also obtained from the perceptual-cognitive system. Their claim is that to obtain objects spatial and temporal knowledge your direct perception through visuomotor modules is not necessary. Because, your knowledge about them is never an accurate metrical knowledge and it is sufficient for you to have relational knowledge of them to navigate through the world or to act upon it. But it should be reminded here, in D.F.'s case, though you don't have a perceptual representation formed when watching an object you are able to act upon it exactly as a normal person does. This shows that you have knowledge about the object, maybe only visuomotor, but you don't have perceptual knowledge. It should be mentioned here that D.F. only lacks in perceptual knowledge. Neither the knowledge of the object in relation to the world (both spatially and temporally), nor perceptual awareness is lacking. You can see actions or the motor knowledge is always coupled with knowledge of the object. Thus, in normal situation, it is the interaction between the proposed systems by Goodale et al., perceptual –ventral stream and visuomotor – dorsal stream, which mediates our knowledge system. Goodale and Humphrey (1998) say, "Certainly there is evidence that, on the neuronal level, the two systems are interconnected, allowing for communications and co-operation between them (Goodale and Milner, 1992; Milner and Goodale, 1995). Thus, although there is clearly a division of labor between the perception and action systems, this division reflects the complementary role the two systems play in the production of adaptive behaviour". It seems, however that the role of actions is not just complementary but a necessary requisite for you to have knowledge at awareness level. In other words whenever you perform an action on an object, it assumes that you have to have knowledge of the object without which you cannot act.

Another perspective on relation among action, cognition and knowledge comes from situated cognition and imitation literature. Kirsh and Maglio (1994) showed that even in a fast-paced task environment like the Tetris video game, players use actions to lower computational load. Tetris involves maneuvering falling shapes (zoids) into specific arrangements on the screen. Players execute actions on the falling zoids, to expose information early, to prime themselves to recognize zoids faster, and to perform external checks and verifications to reduce the uncertainty of judgments. The point of taking such actions is "is not for the effect they have on the environment as much as for the effect they have on the agent" (Kirsh & Maglio, 1994).

Such actions are termed '*epistemic actions*', which are defined as "physical actions whose primary function is to improve cognition by: 1) reducing the memory involved in mental computation; 2) reducing the number of steps involved in mental computation; 3) reducing the probability of error in mental computation" (Kirsh & Maglio, 1994).

The primary computations involved in Tetris are mental rotation of the zoids and matching of zoids to available slots. Participants physically rotate the zoids to significantly lower the amount of mental rotation required to judge the 'fit' of a zoid to available slots. This involves an ongoing visual comparison between slots and the physical rotation. However, a visual comparison is *not* required for actions to aid in mental rotation; actions could contribute to cognition via proprioception (i.e. knowledge of movement). Wexler et al. (1998) show that *unseen* motor rotation in the Cooper-Shepard mental rotation task (Cooper & Shepard, 1973) leads to faster reaction times and fewer errors when the motor rotation is compatible with the mental rotation than when they are incompatible. They also report that in some cases motor rotation made complex mental rotations easier. Also, speeding (slowing) the motor rotation speeded (slowed) the mental rotation. Similar effects have been shown to exist in children (Frick, et al. 2005). Manipulating virtual objects have also been reported to improve subsequent mental rotation and recognition of such objects (Wexler & van Boxtel, 2005).

On a different vein from mental rotations, Kirsh (1995) reports higher accuracy in a coin-counting task when participants pointed at the stimulus, compared to a no-pointing condition. Gestures during cognitive tasks have been shown to lower cognitive load and promote learning (Goldin-Meadow & Wagner, 2005). Humans and other animals exploit head and eye movements to better perceive depth, absolute distance, heading and 3D objects (Wexler & van Boxtel, 2005). Bergen (2004) reports that processing time for sentences involving actions increases when participants perform incompatible actions in parallel.

Besides these, there are numerous other studies that show a possible link between actions and cognition, particularly a large body of imaging evidence shows the automatic activation of motor representations while observing actions (for reviews see Metzinger & Gallese, 2003; Svenson & Ziemke, 2004; Brass and Heyes, 2005, Gallese, 2005). It has also been shown that motor areas are activated more while participants observe human hands than robotic hands, and motor areas are not activated when humans watch actions not part of human repertoire (such as barking). Related studies show more motor activation for dancers while watching dance and pianists while watching piano playing. The emerging consensus in cognitive science is that action plays a crucial role in cognition. Given this crucial role of action in cognition, it is important to understand and analyze the relationship between action and consciousness.

Action and Consciousness

However the relation between action and consciousness is not the same. It does not go without saying that whenever you are acting on an object you are aware of your action being made on it. You might be aware of you acting on it, but you might not be aware of how you are acting on it. These two forms of awareness are different. For example, you might be aware that you are lifting your hand, but you might not be aware of how much you are lifting or how high you are lifting. This seems counterintuitive at first glance. This could be quite well explained if we look at the study done by Goodale and Murphy (1997). They presented participants with five different rectangular objects of the same overall size but different in dimensions. The objects were presented at different retinal eccentricities that varied from 5^0 to 70^0. Participants were asked to categorize these objects into previously instructed categories. Their categorization varied increasingly as eccentricities increased. However, interestingly their aperture of grasp and width of the object were well tuned through out varying eccentricities. This shows that though they are conscious of the categories which they choose according to their perceptual judgments, they are not conscious of their action or motor judgments in grasping. There was another interesting finding in the same experiment. "Although, subjects reported that objects did not look as wide in the periphery as the objects in more parafoveal regions, the aperture of their grasp was actually larger for objects in the peripheral visual field (even though the grasp continued to be well-calibrated with respect to the object's dimensions).

This mismatch between verbal reports and visuomotor control not only emphasize different parts in visual system for action and perception, but also explains the mismatch between knowledge available to consciousness and actions made though you are not conscious of it. This clearly shows that, it is not necessary that whenever you act, you are always conscious of it. There are quite a few results on this sort of dissociation between action and consciousness. In an experiment to test dissociation between vision and action, (Aglioti et. al., 1995) used visual illusions. In visual illusions you are visually aware of a stimulus and its properties which actually do not correspond to the physical measurements of that object. In visual illusions you have access to only to your perceptual knowledge. You do not have access to your motor or action knowledge. They used a three dimensional version (discs instead of circles) of Ebbinghaus Illusion (EI). Ebbinghaus illusion is one where a circle (target circle) surrounded by bigger circles seems to be smaller than when the same circle is surrounded by smaller circles. Aglioti et al.,(1995) presented the three dimensional version of EI in one set of trails where the target circle appeared different though they were identical physically and in another set of trials they physically manipulated the size of the target circle (made bigger) so that they look identical perceptually. Subjects were asked to pick up the circle (or disc) which is there on right side if circles appeared equal in size and if they appear different in size, pick the one on left. Subject's grip aperture was tracked using opto-electronic recording.

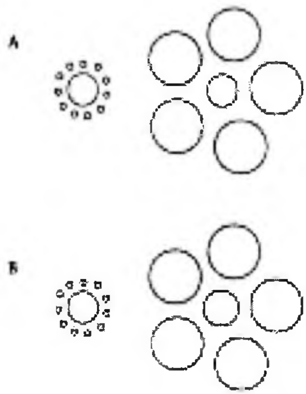

Figure 2: Ebinghans Illusion

The results they obtained were surprising. On trials in which the two discs were perceived as being the same size, subjects opened their hand wider for the larger disc than they did for the smaller one. The calibration of grip size seemed to make no difference to the effects of the size-contrast illusion. This makes our point clearer. Though to your conscious knowledge which you have accessed through perceptual representation, the disc seems to be identical and make judgments based on that, you are in fact, opening your hand accurately corresponding to the physical size of the disc which you are not aware of it. But you do have access to your action or visuomotor knowledge though you are not aware of the output as you are aware of the perceptual output.

Thus it does not become necessary that when ever you act you are aware of your actions. But it is evident that for you to act it is necessary to have some implicit knowledge of the object. In other words whenever you act the knowledge tag of the object on which you act is always tagged to it, and comes along with it. In that sense, all actions lead to knowledge. All actions could be called, in a broader sense, epistemic actions.

Another perspective on the relationship between perceptual experience and action and the role of action in consciousness is the enactive approach to phenomenology, where the central idea is that our ability to perceive qualitative experience is because of our possession of sensorimotor knowledge. Alva Noe (2004) argues that when you see a tomato you also experience its back though you are provided with only the front side through your senses. He attributes the presence of back of the tomato in your experience, though absent to your peripheries, to the possession of your sensorimotor bodily skills. In his view, this knowledge is a practical knowledge rather being a know-what knowledge. On the enactive view, mere sensation, mere stimulation falls short of perceptual awareness. For perceptual experience, a necessary condition is to possess the sensorimotor knowledge and make use of it. "The basic claim of enactive approach is that the perceiver's ability to perceive is constituted (in part) by sensorimotor knowledge (i.e. by the practical grasp of the way sensory stimulation varies as the perceiver moves" (Noe, 2004).

Here experiential content and perceptual content should be made clear. When you see an apple, as mentioned above, you experience the whole apple at once. The experiential content would be wholeness. The experience includes even the presence of the part absent to senses. This presence of the absence part is a construction. Alva Noe argues that to assume this construction as a process of inference, using a set of rules, will lead us nowhere. Because, there could be *n* number of different types of inferences and difference in inferential results, each of us should see and describe different apples. That is not the case. There is a perceptual constancy within me as well as between us.

Experiential content is a qualitative entity, whereas perceptual content is more definitive. To make this point clear, let us take the above example. When you see an apple the experiential content is the wholeness of the apple, along with its other properties, such as redness etc. These are in some sense the objects of perception. Whereas the knowledge content, or the perceptual content, is the shape of the apple - spherical, size of the apple, etc. These are more precise than the qualitative tag of experience.

Alva Noe considers the enactive approach as the more exaggerated version of visuomotor idea and claim that enactive approach does not endorse to the idea that perception is for acting or for guiding action. This may be an extreme position and it is necessary to see whether it can explain a significant number of perceptual phenomena. Let us consider a case documented by Jonathan Cole (1991), which was also mentioned by Alva Noe in his book *Action in Perception*, a patient named Ian Waterman who had lost all sensation from the neck to down, except for the sensation of pain and temperature. He had lost, in particular, proprioception – sense of position and kinesthesis or sense of movement. He possessed a normally functioning motor system. He, however, gained back his motor skills by learning to substitute vision for muscular sense. But if he was unable to view his body, he would just collapse. For him to make movements or to make sense of his muscles he had to use his vision. He had movements and his muscular sense was obtained through vision. His main body-representation that is proprioception, which is direct, is, not functioning. For him to stand or to make movements he has to make use of perceptual system to gain access to body representation. He being able to stand itself is an output action based on perceptual representation. For that he has to form a percept of his body independent of visuomotor knowledge or sensorimotor knowledge. It is not clear how Alva Noe's position on actions explain the experience of this patient, but it is clear that perceptual and action systems interact with each other significantly for perceptual experience and behavior.

As we have mentioned earlier that interaction between two interconnected systems (ventral-what system and dorsal-how system) allows for communication and cooperation between them (Goodale and Milner, 1992; Milner and Goodale, 1995). These interactions create interdependencies. The interdependency could be tracked back to evolution. Perception evolving to aid action. The interdependency might be of two-level as Hurley has proposed. It neither have to be actions arising out of (after) perception – traditional view or perception is due to action component tagged to it – Gibsonian view. These are as she says are one way dependency and instrumental dependency respectively (Hurley, 1998). It is the non-instrumental dependency of the perception system and action system that arouse consciousness. This non-instrumental dependency is a two-level interdependency. This non-instrumental dependency derives its idea from motor theory of perception and control systems theory of action as the control of perception. Further, if we concentrate more on action part of consciousness the internal model theory of motor control can explain how the generation of consciousness (for consciously detecting changes in visuomotor coupled actions) may occur (Frith et. al., 2000; Wolpert & Kawato, 1998). This theory proposes that the signal for conscious detection occurs by integrating visual and motor information. "According to this theory, one predicts the sensory consequences of each motor command and compares the predicted and the actual consequences of the movement. An error signal generated from such a comparison might well underlie the conscious detection of changes in visuomotor coupling....." (Knoblich et. al., 2004). The signal is proportional to discrepancy between two systems and conscious detection in turn is proportional to error signal generated. However there is a threshold level above which if the signal crosses you are consciously aware of the changes. This explains why in Aglioti's (Aglioti et. al., 1995) experiment people were not aware of their action being manipulated depending on the actual size of the object though they were only aware of the apparent size. The theory propose that the threshold for conscious detection is high than for the unconscious detection. In both cases it should be noted that we have still detected the changes i.e we have knowledge of the change. This was well tested in an experiment by Knoblich (Knoblich et al, 2004). In his experiment, participants performed a drawing task in which the relative velocity of actual movement and its visual consequence was varied. The unconscious compensatory movements and conscious detection rates were recorded and compared. There was an invariant relationship between the extent of the change and its detection (conscious). Thus he concluded that conscious detection of change (in visuomotor module) relies on a system that integrates visual and motor information. Another important finding was that figural discrepancies increased the detection rates suggesting that information in 'what' system is important for and facilitate conscious change detection.

Coming back to our question of how Consciousness arises from actions? We take the "Emergence theory" of consciousness. But the emergence is not just restricted, due to the interactions within the brain, which is general traditional view of emergence consciousness. We see emergence of consciousness as embodied in body and world as well. *Consciousness* emergence as a result of adaptations in action (behaviour) to accommodate the changes in the external world. Here we have to make distinction between intentional novel actions and reflexive actions. For example, Sieb (2004) makes a suitable distinction and argues that only intentional novel actions give rise to Consciousness. His argument also goes along the evolutionary lines and is consistent with Goodale's argument that action system came first and then the visual system developed to aid or to complement the former. Hence the ability to generate novel action first evolved in the motor system. However he has suggested that this adaptive behavior is essential for survival success and is restricted to only one point of view of the system i.e self system. Sieb has proposed that this restriction forms our subjective view (experience) which cannot be viewed or experienced by others. Perception provides the animal with a way of looking at information from the world and directly will produce reflexive actions which we see it as analogous to Goodale's direct pathways – visuomotor pathways or reflexive pathways. However, he has argued, to produce novel actions these representations are to be reorganized and rearranged. These rearrangement and reorganization are nonlinear and obeys complex system rules since brain is a system of interacting elements, producing complex behaviour internally. These complex reorganizations are in turn utilized to produce novel and complex action pattern for adaptation (Sieb, 2004). However the reorganization within the system is not explicit and is not available to consciousness. This explains the distinction made between implicit learning and explicit learning as well. Only when you are producing a novel action you are given conscious experience along with it.

Further this reorganization and rearrangement is not just limited to the brain. As in the case of epistemic actions and complementary actions, the reorganization is aimed at the world and occurs in the world. These reorganizations in turn produce adaptive behaviour. The novel action pattern as well the external reorganizing action pattern makes the self-system embodied in the external world. Thus, this indicates of mind and self being extended out in the world (Clark, 1998). Consciousness becomes a natural property of this embodiment by extending itself out in the world as well due to nonlinear interactions between elements within brain. Thus, further scientific research on Consciousness should concentrate on mechanisms in beings that are responsible for novel action behavior (Sieb, 2004) and also the way world involves in reorganization of the mental process as well reorganization of the world by beings. Approaches based on dynamical systems theory should help in studying the relationship between action, cognition and consciousness.

References

Aglioti, S., De Souza, J.F.K., Goodale, M.A., (1995). Size-contrast illusions deceive the eye but not the hand. *Current Biology 5*, 679-685.

Ballard, D. H., Hayhoe, M. M., Pook, P. K., & Rao, R. P. N. (1997). Deictic codes for the embodiment of cognition. *Behavioral & Brain Sciences, 20,* 723-767.

Bergen, B., Chang, N., Narayan, S. (2004). Simulated Action in an Embodied Construction Grammar. In K. D. Forbus, D. Gentner & T. Regier (Eds.), *Proceedings of the 26th Annual Meeting of the Cognitive Science Society*, Chicago. Hillsdale, NJ: Lawrence Erlbaum.

Brass, M. & Heyes, C. (2005). Imitation: is cognitive neuroscience solving the correspondence problem? *Trends in Cognitive Sciences, 9,* 489-495.

Clark, A., & Chalmers, D. J., (1998). The Extended Mind. *Analysis 58*, 10-23.

Cole, J. (1991). *Pride and the daily Marathon.* London: Duckworth.

Frith, C. D., Blakemore S. J., & Wolpert, D. M. (2000). Abnormalities in the awareness and control of action. *Philosophical Transactions of the royal Society of London. Series B, 355*, 1771-1788.

Gallese, V., Fadiga, L., Fogassi, L., & Rizzolatti, G., (1996). Action recognition in the premotor cortex. *Brain, 119*, 593-609

Gallese, V. (2005). Embodied simulation: from neurons to phenomenal experience. *Phenomenology and the Cognitive Sciences, 4*, 23-48.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston: Houghton Mifflin.

Goodale, M. A., Milner A. D. (1992). Separate visual pathways for perception and action. *Trends in Neuroscience 15*, 20-25

Goodale, M. A., Murphy, K., (1997). Action and perception in the visual periphery. *In: P. Their, H.-O. Karnath (Eds.), Parietal Lobe Contributions to Orientation in 3D Space.* Sringer-Verlag, Heidelberg, pp. 447-461.

Goodale, M. A., Humphrey K. G. (1998). The objects of action and perception. *Cognition, 67,* 181-207.

Hommel, B., Müsseler, J., Aschersleben, G., & Prinz, W. (in press). The theory of event coding: A framework for perception and actions. *Behavioral and Brain Sciences.*

Hurley, S., *Consciousness in Action.* (1998). Harvard University Press.

Kirsh, D., & Maglio, P. (1994). On distinguishing epistemic from pragmatic action. *Cognitive Science, 18*, 513-549.

Kirsh D. (1995). Complementary Strategies: Why we use our hands when we think. In *Proceedings of the Seventeenth Annual Conference of the Cognitive Science Society*, Hillsdale, NJ: Lawrence Erlbaum.

Knoblich, G., & Kircher, T. T. J., (2004). Deceiving Onself About Being in Control: Conscious Detection of Changes in Visuomotor Coupling. *Journal of Experimental Psychology: Human perception and Performance, 30*, 657-666

Liberman, A. M.., & Whalen, D. H. (2000). On the relation of speech to language. Trends in Cognitive Science, 4, 187-196

Merleau-Ponty, M., (1962) *Phenomenology of Perception*. Trans. Colin Smith. London: Routledge & Kegan Paul.

Metzinger, T & Gallese, V. (2003). The emergence of a shared action ontology: Building blocks for a theory. *Consciousness and Cognition, 12*, 549-571.

Milner, M. A., Goodale, A., M. (1995). *The Visual Brain in Action*. Oxford University Press, Oxford.

Noe, A. (2004). *Action in Perception*. Cambridge, MA. MIT Press.

Sieb, R. (2004). Emergence of Consciousness. *Medical Hypothesis, 63*, 900-904.

Svenson, H. and Ziemke, T. (2004). Making Sense of Embodiment: Simulation Theories and the Sharing of Neural Circuitry between Sensorimotor and Cognitive Processes. In K. D. Forbus, D. Gentner & T. Regier (Eds.), *Proceedings of the 26th Annual Meeting of the Cognitive Science Society*, Chicago. Hillsdale, NJ: Lawrence Erlbaum.

Wexler, M., & van Boxtel, J.J.A., (2005). Depth perception by the active observer, *Trends in Cognitive Sciences, 9*, 431-438.

Wexler, M., Kosslyn S.M., & Berthoz, A. (1998). Motor processes in mental rotation. *Cognition, 68*, 77-94.

Wolpert, D. M., & Kawato, M. (1998). Multiple paired forward and inverse models for motor control. *Neural Networks, 11*, 1317-1329.

The Puzzle of Experiential Primacy and Consciousness

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The major epistemological worry faced by the empirical analyst, the philosopher and the psychologist is based on the central feature of 'consciousness' – 'experience'. This worry is commonly described as how to have a theoretical explanation for the mutual influence of neural events and subjective experiences and which one (neural events/subjective experience) is the defining characteristic of consciousness. Interestingly, any attempt to understand 'experience', such as simple physical pain or much complex psychological pain, will have to cross the epistemological barriers of hierarchies and causal relationships, demanding a non-linear path. The classical description of consciousness as 'unitary' has even evolved, to accommodate the questions emerging in interdisciplinary dialogues, to present the term 'self' which was once considered metaphysical, but very much available for scientific discussion today. The epistemological transition, however implicit it is, is from a third-person perspective to a first-person perspective.

A distinctive trend in 'consciousness' discussions started with the theory of 'easy problems and hard problem' by David Chalmers (1995, Chalmers) which for the first time in the Western world made a semantic distinction between 'being conscious' and 'what is responsible for consciousness'. Both experimental and cognitive science took into cognition the strong presence of an 'explanatory gap' (1987, Jackendoff). Though the approaches still remained/

remains reductionistic or atleast dualistic in explanations the complexity of 'consciousness' and its unique nature in contradistinction with any other phenomenon in the lab was largely accepted. This acceptance inspired theories favouring complex cognitive and social functions, neural and subneural structures, system-environment interaction etc. inorder to fill the 'explanatory gap' and place 'consciousness' in its seat.

The views that are currently discussed and debated no more fall into a strict division of reductionistic and non-reductionistic approaches. This could be because of the recognition, in these approaches, of a distinct characteristic of 'consciousness', namely that it is not strictly linear, and also because of the need for bridging first-person and third-person worlds. One of the prominent view is that there is a distinction between subjective conscious experience and the biological mechanisms responsible for these, and their mutual non-reducibility. This view is based on the position that first-person data cannot be fully understood in terms of third-person data (2000, Chalmers) Biological explanations have also factored a hierarchy of functions inorder to explain consciousness. One such view holds that consciousness is a highly complex motor response occupying 'the uppermost echelon of a hierarchy having the primitive reflex at its base' and that which 'arises from the systems' interactions with the environment'(2001,Cotterill).

Approaches to explain consciousness as epiphenomenal, but not in the classical sense of emerging from a physical composite, also take into account that the primary problem for explanation is more than a theoretical divide between the empirical and the subjective aspects of consciousness. Therefore, some of these approaches hold that consciousness 'is formed in the dynamic interrelation of self and other, and therefore is inherently intersubjective' (2001,Thompson) or that it is a system of interactions between the animal and its environment and that it is not located in the brain (1991,Varela et.al.). Explanations that address the psychological and social dimensions of consciousness hold that consciousness is 'some pattern of activity in neurons' (1997, Churchland) or that it is best understood in terms of varying degrees of 'intentionality' (1991, Dennett), and in terms of 'memes' which are the units of cultural evolution (1976, Dawkins; 1999, Blackmore).

Yet another school of thought that strongly upholds the need for finding neural correlates for the subjective components of consciousness is interested in the scientific exploration of meditation techniques. This school acknowledges the contribution of Eastern philosophy and wisdom traditions for a very specific role, which is, towards understanding and practicing meditational techniques for transcendental and extra-ordinary states of consciousness and experiences (1999, Shear).

It is interesting to see that much of these discussions consider consciousness as a phenomenon to be *understood* and that it is much within the scope for investigation and dialogue like any other phenomenon. There is a degree of equal balance between two basic explanations/approaches for consciousness such as (i) neural/physical/social correlates (ii) extra-ordinary and meditational (transcendental) experiences mostly validated by neural or other third-person data.

The Puzzle of Experience

The questions we ask about consciousness have their bases on different kinds of experience, whether it is dream, states of mind, memory, pain (physical and mental) etc. But the analysis for these questions is based on segregated information about behaviour or brain events and processes. Therefore, the answers to these questions are given in terms of neural correlates and neural information processing and models thereof. This method takes of the essential aspect of 'being conscious' or 'consciousness' which is the 'person'. Questions asked as a result of first-person experience are given answers that are founded on third-person information. Essentially, there is a gap between the problematic of conscious experience and the attempts to address it, which I call as the 'harder problem' (Menon, 2001). The standards and criteria that we follow for objective understanding are most often the criteria for third-person information. This method helps us to build technologies and to understand abnormalities transcending individual existences. The first-person qualitative methods give us opportunities to be sensitive to the individual nature, psychology, expressions and uniqueness.

If both methods are important, how could the 'harder problem' be addressed? I do not have a ready answer for this question. But we could attempt a method that will not be mutually converting (information to experience and experience to information), reductionistic or solipsistic. Meaning, we should avoid the presumption of the larger picture of consciousness emerging out of solely third-person or first-person methods. The 'harder problem' is not a question, I think, to be answered completely, or a complete theory about consciousness. Rather, it is the ontological essence of 'consciousness' that should always be addressed to whichever method we adopt, that will help us to *see* something more than the third-person information and the first-person experience.

The availability of 'consciousness' for our most intimate experiences and yet our inability to understand it *completely* in terms of third-person information makes us to think that 'consciousness' is a complex phenomenon, and that its complexity need to be addressed. We understand 'complexity' as an intrinsic characteristic of the 'other', the object of investigation, which we attempt to study. This notion of ours about 'complexity' is to be examined.

When we reduce different expressions and features of a phenomenon to one or two or to some quantity, we have to remember that it certainly is the only possible way of understanding something so multifaceted and simultaneous, and therefore could be called as a simple method. But such a method need not be the final and complete method, and not the complete third-person representation of the first-person phenomenon. Complexity could be the characteristic feature needed for the design for providing third-person representation. May be, what we distinguish as 'simple' and 'complex' are not the intrinsic characteristics of the object of investigation, but the categories of thinking and understanding we have formed according to the third-person information supplied to us by the tools we have designed. Hence, the question 'should design and tool be complex' becomes important.

Also, therefore, the standard scientific criteria of replicability cannot be applied since the third-person representation cannot be a replica of the complete first-person phenomenon but only a *representation* of it from a particular framework that follows certain epistemological and empirical/theoretical parameters.

Experiential Primacy

According to Chalmersian theory of 'easy problems and hard problem' first-person data cannot be subjected to the standard method of reductive explanation. This theory also questions the basic fact of consciousness, that is, why is the performance of neural functions accompanied by subjective experience?

The 'why' question here is pertinent to understand the bases on which we find our primary, secondary and tertiary questions and methods for understanding 'consciousness'. Why 'why'? The 'why' question ('why neural functions are accompanied by subjective experience') assumes:

(i) consciousness as a separate 'something' borne or unusual/non-natural,

(ii) (neural) functions as basically having only mechanistic meanings, and,

(iii) subjective experience as not the intrinsic nature of consciousness.

These assumptions that are indirectly upheld by the camp of anti-reductionism stem from the basic conflict between 'experience' and 'cognition'. The normative criteria for establishing 'truth' start from the objective reduction of whatever is posited. Here subjective experience falls out of normative standards for agreeing upon something as valid. So, the why-question as well as the assumptions arises from the conflict we encounter between epistemological necessity and experiential primacy. Both seem to be unavoidable and co-existent in human discourse.

It is difficult, if not impossible, to resolve a conflict if both the components of it are equally important. But, the recognition, of this unavoidable conflict itself, in our theories and models, will help us to widen the scope of investigation and prevent de-humanisation of the goals we seek for fulfilment. After all, through both third-person information and first-person experience what we ultimately seek are personal growth and health, co-existence and sharing, and a continuous exploration into the unknown and the unpredictable.

A prologue before we set forth the theorisation and definition of the problem will be helpful for a student of 'consciousness'. This prologue will elucidate the primary division of a set of agenda based on direct first-person experience and the consensus we share on perceived facts. The primary division will be of the meaning and scope of 'awareness of something' and 'awareness by itself'.

What exactly is 'self awareness'? It is awareness of something. It is either the awareness of: (i) the world outside, such as other states of mind, objects, etc. (ii) the world inside, such as 'my emotions', 'my perceptions', 'my body', 'my identity' etc. The 'world inside' cannot be understood without the intervention of self-reflection and self-participation. What is 'awareness itself'? Awareness itself can be seen as (i) uniting discrete thoughts, and the two worlds (inside and outside), (ii) as meta-awareness of the two (inside and outside world) awareness-es, (iii) as pure I-ness.

Unless a clear distinction is made between these different categories of existence, for our thinking and analysis, we will end up searching the needle in the same haystack for centuries without realising that the problem is not just the subtleness of the subject of our inquiry but our own inability to design a comprehensive search. The design of the comprehensive search is important because the way we search for it is going to alter the presence of it in the invincible heap.

Indian Routes for Dialogues

'Consciousness' has become the umbrella term for debating many issues crossing disciplines yet connecting disciplines. This is interesting. Because, given the variety and differences in the themes and ideas for human discourse, to have a common factor in our dialogues seems to be difficult. The route and the possible result of this dialogue is to connect and joint various streams of thought whether, empirical or intuitive, experimental or theoretic, inorder to map and place consciousness. On a scale of meta-analysis, this is a linear and horizontal approach, essentially because our dialogues start from third-person working definitions we assume (however different they are) of 'consciousness'. Nevertheless, contributions made by dialogues that could be clubbed under the term 'consciousness' is eventful, since they are an attempt to harmonise and integrate otherwise divergent human thinking.

The Eastern wisdom traditions, beginning from the Vedic system of thought, perceived of entities (physical/metaphysical) whose existence are different by being connected with the outside world of objects and the inside world of experiences. There are several verses in the *Brahmanas* that imply the quest for the source of knowledge and experience. Beginning from the origins to the classical schools and saints of Indian philosophy and wisdom traditions the focus is not to begin from the outside variety and unite the units by an emergent phenomenon, even if we take the most realist schools.

Epistemological analysis, in Indian thought, is subservient to experiential paradigms. Indian schools of thought, in general, have one common thread – that is to relate to a larger, deeper and holistic concept/entity called 'self'. Whether it is for affirmation or denial, Indian thought engages in rich analytic thinking to form a philosophy about 'self'. Both analysis (structured and 'leading-to-next' kind of hierarchical thinking) and experience are used as epistemological tools in an integral manner to form distinct but inter-related ontologies. Metaphors and imageries are used as epistemological tools for creating transcendence in thinking and thereby experiencing. The aim is not to arrive at structured and classified/listed knowledge of an*other* object/phenomenon but understanding in relation to an abiding entity whether it be the self/no-self/matter.

Another interesting feature of Indian philosophical thinking is the importance given to the way of living or lifestyle subscribed to by the schools, no matter how realistic or idealistic their metaphysical position is. The understanding of a particular school of thought will not be fulfilled by 'understanding' its epistemology or even world-view but by following a lifestyle which is prescribed. Experience is the core of understanding. This would primarily require the student's mind to follow certain rules and discipline of forming integral and inter-related connections than individual and isolated relationships. This is a major difference when we compare with the dialogues in the West on 'consciousness'.

The therapeutic value of analysis and self-oriented integration of understanding is given more importance than its cognitive value, in their philosophical thinking. The reference for the starting premises and concluding thoughts is the 'person' and his/her experience and the situation he/she is in. The route taken is from the situation of the person (as 'given') to the reorientation and re-organisation of his/her response based on transpersonal experiences. The most part of imagination and striving is for what is possible from what is given (Menon, 2003). Hence the style of discourse adopted in their presentations is more metaphorical and non-linear than hierarchical and localised.

The classical approach to spiritual experiences is to disengage from 'ordinary' experiences and engage in for 'transcendental experiences'. The implication in such an approach is that there is a division between, and a travel from, the 'ordinary' to the 'transcendental' experience. The major thesis which is missed is that spiritual experience is not another kind of experience in another world and relating to another set of objects forsaking and condemning the given 'ordinary' experienced world to be of a hierarchically lower order. Spiritual experience, according to Advaita, is reorienting and there by reconstructing any experience from the Self's point of view. The ontological thesis, of Sankaracharya, upholds I-consciousness as 'something-which-is-already-there'. Spiritual experience is reconstructing any experience from this ontology. 'It is there across, above, below, full, existence, knowledge, bliss, non-dual, infinite, eternal and one' (*Atmabodha*).

The difference between an 'ordinary' experience and a 'spiritual' experience is that in the former case the experience is given meaning from the point of view of self and in the latter case it is from the point of view of Self. In both experiences there is an identity that relates to and generates meanings. In the first case the identity is caused and defined by the situation. In the latter case the identity defines the situation by responding to it from an integral point of view.

This thesis could be subjected to skepticism and criticized as *ad hoc* rationalization for not being soteriological. It is also one of the reasons why consciousness described by Acarya is often mistook as *niskriya* (inactive) in its literal sense. The notion of *maya* too has invited many misconceptions about it, the major one implying a passive homogeneity to pure consciousness. The main argument behind such misconceptions can be traced back to a monistic labelling of Advaita.

Current discussions on 'consciousness' mostly focus on either of the two problems: how simple physiological functions co-ordinate and work together as one single system; how and why a subjective orientation ensues. Will the focus on the ontology of Self and human experience will give a different picture about consciousness? In the first case the attempt is to build into 'consciousness' and in the second case the attempt is to build from 'Self'. Categories of thinking needed for the two cases are different. One is for the allocation of new knowledge within a system, and the other is for transformation of knowledge a-systemically. Experience is the common concern and mystery for both the discussions, though it is not the beginning point for the first school of discussion. But can we give up the experiential primacy of consciousness totally or give secondary importance? Seems not to be so easy, and more importantly, less meaningful.

References

Adi Sankaracarya, (1987) *Atmabodha*, Bombay: Central Chinmaya Mission Trust.

Blackmore, (1999) *The Meme Machine*, Oxford University Press.

Daniel Dennett, (1991) *Consciousness Explained*, London: Penguin Books.

David Chalmers, (1995) 'The Puzzle of Conscious Experience', *Scientific American*, December, pp.62-68

David Chalmers, (2000) *The Conscious Mind: In search of a fundamental theory*, Oxford University Press.

David Chalmers, (2000) www.nih.gov/news/NIH-Record/06_27_2000/story01.htm, presentation at the symposium entitled *Scientific Approaches to Consciousness: Reductionism Debated.*

Evan Thompson, (2001) 'Empathy and Consciousness', *Journal of Consciousness Studies*,vol.8, No.5-7, pg.1

Francisco Varela, Evan Thompson & E. Rosch, (1991) *The Embodied Mind: Cognitive Science and Human Experience*, Cambridge: MIT Press.

Francisco Varela & Jonathan Shear, (1999) Ed. *The View From Within: First Person approaches to consciousness*, England: Imprint Academic.

Rodney M.J. Cotterill, (2001) 'Evolution, Cognition and Consciousness', *Journal of Consciousness Studies*,vol.8, No.2, pg.4

Sangeetha Menon, 'Towards a Sankarite approach to consciousness studies', *Journal of Indian Council of Philosophical Research*, Vol. XVIII, No.1, January-March 2001, pp.95-111

Sangeetha Menon, *Binding experiences for a first person approach: Looking at Indian ways of thinking (darsana) and acting (natya) in the context of current discussions on 'consciousness'* In: On Mind and Consciousness (eds Chhanda Chakraborti, Manas K Mandal and Rimi B Chatterjee),Indian Institute of Advanced Study, Shimla and Department of Humanities and Social Sciences Indian Institute of Technology Kharagpur, pp 90-117

Paul S. Churchland & T. J. Sejnowski, (1997) *The Computational Brain*, Cambridge: MIT Press.

Richard Dawkins, (1976) *The Selfish Gene*, Oxford University Press.

Ray S. Jackendoff, (1976) *Consciousness and the Computational Mind.* Bradford: MIT Press.

Consciousness, Self and Metaphor

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Consciousness has been treated, for long, as an elusive phenomenon mainly because of its subjectivity making it less amenable to objective and empirical studies. Recently, it has become a major focus in the field of cognitive studies with the efforts from different fields such as neuro science and psychology to understand and explain the phenomenon of consciousness.

Even though a strict definition of consciousness is hard to make, it is generally considered to be an umbrella term covering subjectivity, awareness and sentience. A distinction is often made between phenomenal consciousness and access consciousness.[1] The former refers to the experiential aspect considered independent of its effect on behaviour and the latter refers to that phenomenon by which information is made available for verbal report, inferential process and so on. The phenomenal consciousness is considered to be giving rise to the 'what it is like' aspect of consciousness and is called qualia. Explaining phenomenal consciousness is treated to be the hard problem of consciousness studies as the experiential aspect seems to be lying beyond the ken all objective descriptions. This goes to the extent of saying that "it is humanly impossible ever to understand how technicolor phenomenology can arise from grey soggy matter."[2]

But there have been attempts to explain consciousness, including the phenomenal aspects, as a natural phenomenon. The strategy involves treating consciousness as the result of evolution with definite functional advantages. Daniel C.Dennett's Multiple Drafts Model(MDM) of consciousness is a comprehensive approach in this regard.

Multiple Drafts Model

With regard to consciousness, it is common to think of it as being located somewhere in the brain. Dennett calls this view Cartesian Materialism (CM) or Cartesian Theater.[3] It holds that there is some place in the brain where arrival of information is equivalent to becoming conscious of it. There is an implication of a stage and an audience for whom the actions are performed. It is referred to as Cartesian because it is the result of clinging to the legacy of Descartes after discarding dualism and it is a form of dissimulated dualism. An example of the such a view is the statement of Crick and Koch that one of the functions of consciousness is to present the result of various underlying computations.[4]

The problem of Cartesian Materialism becomes apparent when we look at the ways in which our experience occur. It is well known that light travels faster than sound and, therefore, information about light should reach the brain much before that of sound comes. Yet, we can have a unitary experience of fireworks. What it implies is that our consciousness is not direct and immediate and the very questions of 'where' and 'when' of consciousness do not get exact answers. It is to be noted that this problem appears at microscopic intervals such as milliseconds at which brain processes take place.

Cartesian Materialism has got a logical problem as well. If there is a point in brain that can be regarded as the locus of consciousness, then what is it that makes that point conscious of? This leads to the problem of infinite regress. The better way to tackle this problem is to treat consciousness as a matter of degree and not as an all-or- nothing thing.

MDM attempts to do away with the imagery of a locus of consciousness by treating the whole mental realm as a parallel track of processes. Let us have a look at the central claims of this models and why Dennett claims it to be the best way to explain several anomalies observed in relation with the phenomena of consciousness.[5]

The fundamental tenet of MDM is that all varieties of thought or mental activity are accomplished in the brain by parallel processes of both interpretation and elaboration of the information given by the sensory organs and these editorial processes occur over tiny fractions of a second. This much is, by and large, universally accepted. What makes MDM a radical thesis about consciousness is that it contends that all these feature detections or discriminations take places only once and there is no special place in brain where discriminated content again goes for a re- discrimination and appears in the stream of consciousness. Thus what gets discriminated in any part of the brain need not be necessarily a part of consciousness. The different content-discriminations yield different narratives and what appears in consciousness, according to Dennett, is the result of probing of those narratives. This denial of consciousness having a locus in brain is what makes MDM radical and intuitively less appealing as it also implies that there is no 'when' and 'where' regarding consciousness. But what lacks intuitive appeal may be scientifically valid. This is what the difference between 'manifest image' and 'scientific image', as drawn by Sellars, shows.[6]

In order to make clear what MDM amounts to, it is necessary to look into some case studies that Dennett discusses. All such cases involve rapid temporal sequences and show the limits of the powers of the brain and, presumably, shed light on the dark areas of the brain such as consciousness. The most interesting thing is that, these are the very same cases, based on which Karl Popper and John Eccless have argued for a dualist position.[7]

Consider the case of phi phenomenon where apparent motion is created with the rapid succession of still pictures. Experiments show that if the two spots are of different colours, say, green and red, then the first spot will be seen as moving and then changes its colour from green to red in the middle of its illusory passage.[8] Here, the problem is how this gap is filled in, that is, how can there be a precognition of the red colour before that spot is perceived? For Popper and Eccless, this implies something supra physical, but for Dennett, these sorts of problems are due to our fundamental misunderstanding of what constitutes consciousness and the subsequent conceptual errors.

In fact, there are several such cases with anomalies in the temporal properties of consciousness. Apart from the dualist interpretation *a la* Popper and Eccless, there are other attempts to explain them. Goodman speaks of them as cases of "projection backwards in time" implying some twisting of normal cause-effect relationship.

But the explanation that Dennett gives is to look at consciousness through the MDM model and then all these paradoxes disappear.[9] One important point to be kept in mind, while dealing with all such paradoxes, is that brain is at constant pressure to act and,therefore, time becomes a big constraint. When a lot of things happen, there has to be some simplification to be done so as to cope with the constraints of time and efficiency and this may be done at the expense of accuracy. What happens in the case of phi phenomenon is that the processing that there is a red spot and the processing that there is a movement are done at the same time and this amounts to the report that the spot has changed its colour from green to red. Hence it seems that there is an anomaly but this all due to the microscopic intervals of time involved and the enormous amount of data that the brain has to handle. There is no filling in the information, as has been suggested by many to explain the anomaly, as there is no re discrimination for consciousness to take place. It is the bedevelling notion that there is something inside that sees everything, that gives rise to the view that there has to be some sort of filling in the gaps. Once that is done away with, then it can be accepted that there are so many gaps in our consciousness with the presence of phenomena like change blindness. As Marvin Minsky puts it, "our sense of continuity comes from out marvelous insensitivity to most kinds of changes rather than from any genuine perceptiveness."[10]

Dennett contends that the brain makes use of an ingenious mechanism distinguishing features of representings from feature of represented. Such a distinction is implicit in the common distinction made between content and vehicle. This means the temporal properties of the vehicle need not be isomorphic to that of the content. This is usually made in the case of spatial properties. For instance, the top sentence in the description of a man need not be about his head. This is be applicable to temporal properties as well.

Given this, the brain can work with the information that A happened before B irrespective of whether information about A has reached first or not. The temporal properties of consciousness need not be as that of the objective sequence of happenings. In other words, brain can represent time by using a medium other than time itself. So the subjective order of temporal experience need not match the objective order of discrimination. This can be fully appreciated only if the additional point that the discrimination of any information does not imply its presence in consciousness is also taken note of.

What appears as conscious, according to Dennett, is the result of probing for subsequent report. As probing does not take place at all time, it is not continuous. This is indeed difficult to swallow as continuity is considered to be the hall mark of consciousness. But this can be appreciated that once we realize that in the scheme of MDM, there is not only no locus of consciousness but the very difference between the conscious and the unconscious is one of degree.

The feeling of the unified stream of consciousness depends upon the time scale at which we view it. When we go to the microscopic time levels at which brain processes occur, there are several parallel streams of content-fixing events, each of which is done by a specialised subsystem in the brain. These different events can be taken to be forming different narratives out of which one cannot be considered as the canonical narrative. But when there is a 'probing' of what is going on then there appears a stream of consciousness and which one will form part of it depends upon the nature and timing of the probe. In fact, we do this probing most of the time in the form of talking to oneself and we are not even aware that we do it. This results in the notion that there is a stream of ever present consciousness, but this is far from the case.

This constant self probing is inculcated in us mainly through language and culture. In fact, without language this would not have been possible at all. This makes clear that emergence of language and consciousness go in tandem. Cultural knowledge is transmitted through memes[11] and this transmission is done mainly through language. In fact, Dennett reaches the conclusion that human consciousness is to a very great degree a product not just of natural selection, but of cultural evolution as well and the human mind is itself an artifact created by memes.

This leads Dennett to formulate the following position, "Human Consciousness is itself a huge complex of memes(or more exactly, meme-effects in brains)that can best be understood as the operation of a 'von Neumannesque' virtual machine implemented in the parallel architecture of a brain that was not designed for any such activities."[12]

The importance of language, according to Dennett, lies in helping in communication among different parts of the brain and as a vehicle of memetic transmission. Language constitutes the paradigm case of serial processing in brain, which is fundamentally a parallel machine. It is obvious that the capacity to do serial processing makes human brain to do things such as logic and mathematics which other species cannot. All this would not have been possible had it not been for the presence of language.

Thus language, consciousness and culture all are inextricably linked together in the Dennett's scheme and there is a fundamental difference in the nature of consciousness from the rest of the brain processes. Anomalies are attributed to the properties of consciousness because the nature of consciousness is misunderstood and is treated as other brain processes.

The MDM account of consciousness cannot be treated to be comprehensive without dealing with the problem of qualia. 'Qualia' refers to qualities or feelings such as redness, bitterness considered independently of their effects on behavior. There has been a lot of debate concerning its ineffability arguing that the very presence of qualia gives rise to the feeling of 'what it is like to be' which cannot be explained through any third person stand point.

The strategy that Dennett adopts is to do away with the very notion of qualia treating it as simply the result of our muddled way of conceptualizing. So in true Wittgensteinian spirit, he tries to eliminate the confusion that bewitches us. Let us have a look at some of his thought experiments to drive home the point that there is nothing left to consciousness other than the reports or the very basis of the distinction between phenomenal and access consciousness is dubious.

He enumerates four characteristics, considered to be , constitutive of qualia. They are: ineffable, intrinsic or non-relational private and directly or immediately apprehensible in consciousness. All these properties amount to making qualia something beyond the ken of any intentional or functional explanatory paradigm. The main argument is that you cannot know of it unless you have it. It is this first person authority that Dennett wants to demolish and he proceeds by arguing that all these qualities enumerated above are really not there.

His attack is based on several thought experiments or intuition pumps called the "neurological prank experiment". Suppose the qualia of some one is inverted by a neurosurgen, that is, for him, grass appears blue and sky appears green. He will be unable to tell whether there is any change in the immediately apprehensible qualia as it is possible that either his qualia itself is inverter or his connection to past memories of qualia is inverted. But if qualia has got the properties of non-relationality, he should be able to tell what is actually the case.

The same point is made more clear in this case. Suppose X and Y used to like a particular brand of coffee. But one day both of them start disliking it. X defends the change by saying that the very taste of that brand has changed but Y says that the taste continues to be the same but he no longer likes it. Now there is no way one can say who is right as there is no fact of the matter in this case.

It is only in the scheme of Cartesian Theatre that qualia rules as there is some one for whom the intrinsic properties appear to. Once that is demolished, the rest follows suit. What it is like to drink a coffee is just a matter of how one reacts to the coffee and not the putative quale.

Thus qualia is nothing but the disposition to behave in certain ways. It has nothing private or ineffable in it.

Also there can be qualia only if there is a precise answer to the question concerning the where and when of consciousness. Thus, at most, these properties are disposition and they can be explained in functional terms. Thus he explains all that is there to phenomenal consciousness in terms of access consciousness.

Thus, to conclude, it may be stated that consciousness, within the framework of MDM, is only a train of thought and a sophisticated sensitivity towards the world coupled with the sense of a self. There is nothing ineffable, all-or-nothing property in it.

The Self as the Center of Narrative Gravity

Having said this much about consciousness, the question concerning the nature of the self cannot be left unanswered.[13] In fact, our view of self and that of consciousness go in tandem. So in Cartesiam Materialism, the self can be treated as the real agent as it is accepted that there is a center where all mental processes go together. But MDM demolishes this saying that all that there is a huge pandemonium of parallel processes giving rise to different narratives, out of which some get attended to, thereby resulting in the feeling of consciousness.

Fixing the boundary between itself and the rest of the world is necessary for any organism lest the very survival should be at stake. This is the biological self. But at the level of human thought there is the notion of the self which considers itself to be the thinker and the doer of actions. The reality that can be attributed to this entity will depend upon one's attitude towards the whole of folk psychological categories. Dennett is an instrumentalist in this regard and his views on self follows a similar line.

According to Dennett, self can be called the centre of narrative gravity. Centre of gravity of an object, in Newtonian physics, is the point to which all gravitational forces are calculated and it is basically fictional. But it plays a significant role in predictions and explanations. For instance, when we tip a physical object, say a chair, we can predict more less accurately the moment at which it will start falling down. This is based on taking into account the center of gravity of that object. Similarly, the narratives that are formed with the activities of the brain require a center to organise interpretation and the notion of self is that center. Fictional characters are indeterminate and this indeterminacy goes in tandem with the instrumental approach that Dennett adopts towards the reality of folk psychological categories. He declares that to ask where is the self in the brain is to commit the category mistake. It is basically a narrative entity and, therefore, no independent, free floating status can ever be attributed to it and it is not in command of the resources of the mind.

Thus MDM gives a comprehensive account of consciousness. The fundamental principle is that there is no where and when to consciousness and then the rest of the things concerning qualia and the self follows suit. It champions a reconciliation between the two conflicting paradigms of behaviorism and cognitivism.

The Self as a Metaphor

The message that comes from MDM model of consciousness is that it is epiphenomenal. Most of the mental activity goes on at the unconscious level. George Lakoff, one of the pioneers of cognitive semantics, takes cue from the recent developments in cognitive science and aims at reformulating the whole edifice of Western Thought based on its findings. According to him, the three central claims of cognitive science, having overall philosophical imputations are: (1) Mind is inherently embodied, (2) Most mental activity is unconscious and (3) Abstract concepts are all metaphorical.

The notion of metaphor plays a major role in the analysis of language undertaken in the tradition of cognitive semantics whereas it is treated to be an aberration in formal semantics.[14] The embodied nature of mind shows that capacities such as reason and language use are not independent of other processes like perception. Thus bodily metaphors come to play a large role in the formation of abstract concepts. Lakoff contends that most of our ordinary conceptual system is metaphorical in nature. For example, affection is understood through the metaphor of warmth because in childhood these two experiences often co-occur. The metaphorical nature of the conceptual system is often overlooked as most of the processes at the conceptual level are unconscious and phenomenological analysis can hardly reveal them.

The essence of a metaphor is to understand one thing in terms of another. This can have negative effects as it may cloud the real nature of the phenomenon concerned. For example, the metaphors often used for mind in the statements such as 'thought is language' or 'mind is a machine' overlook the embodied nature of the mind.

The study of self deals with the structure of our inner lives consisting of different sorts of experiences and,accordingly, several metaphors are used to capture the notion of the self. The most common division made is between the Subject and different selves. The former is often conceptualized as the locus of reason, consciousness and will. It is considered as disembodied and metaphorised in terms of a person. The latter concerns the body and different social roles and they are metaphorised accordingly either as a person or as an object or as a location. The distinction between the Subject and different selves is made clear in the statements like "I am at war with myself".

The fallacies associated with the notion of the Subject are obvious. First of all, as the MDM shows, there is nothing that is the ultimate controller and the very notion is logically untenable as it gives rise to an infinite regress. Moreover, it gives rise to the impression of being unique overlooking the commonality that exists, being the members of the same species. Lakoff even suggests that the influence of religion and spirituality on humans may be due to treating the Subject as something disembodied as this easily leads to believing that something transcendent lies above this body and world.

Conclusion: Towards a Remedial Amnesia

It may be objected that without the Kantian autonomous person, with absolute freedom and transcendent reason, morality will suffer and devastating consequences follow. But this criticism seems to be unwarranted. It may even be the case it is the illusory self that underlies most of our problems. As J.Krishnamurti puts it, " the inability to face what we actually are and living with all sorts of misconceptions about the 'me' lie behind the endless division, conflicts and destruction that we witness."[15]

An empirical understanding of consciousness and self may pave the way for a holistic outlook towards oneself and the world and consequently, a better way of life. Perhaps, this is the only way to go beyond the centuries of conflict without falling back into the pattern of further divisions and destructions.

Notes and References

1 Block, N (1995) On a Confusion about the a Function of Consciousness, *Behavioral and Brain Sciences.* 18:2,pp227-287.

2 McGinn, C (1989) Can we solve the mind-body problem? *Mind*, XCVIII:891, pp 349-366.

3 Daniel C. Dennett (1997) The Cartesian Theatre and the "filling in" the stream of Consciousness. in *The Nature of Consciousness:Philosophical Debates* ed. by Ned Block, Owen Flannagan and Guven Guzeldere (MIT Press: Cambridge) pp83-89.

4 Crick, F. And Koch, C. Towards a Neurobiological Theory of Consciousness. *Seminars in the Neurosciences*, 2, pp. 262-275

5 Dennett, D. C (1993) *Consciousness Explained* (Penguin Books)

6 Wilfrid Sellars (1963) Philosophy and the Scientific Image of Man in *Science, Perception, and Reality (*Routledge and Kegan Paul, Ltd: London)

7 Karl Popper and John Eccless (1983) *The Self and its Brain: An argument for Interactionism.* (Routledge & Kegan Paul: London.)

8 Goodman, N (1978) *Ways of World Making (*Hassocks, Sussex: Harvester) P73

9 Daniel C. Dennett and Marcel Kinsbourne (1997) Time and the Observer: The Where and When of Consciousness in the Brain in *The Nature of Consciousness: Philosophical Debates* ed. by Ned Block, Owen Flannagan and Guven Guzeldere (MIT Press: Cambridge) pp 141-175.

10 Minsky, M (1985) *The Society of Mind.* (Simon & Schuster: New York) p.257.

11 The term meme was first coined by Richard Dawkins in *The Selfish Gene* (OUP, 1976) to refer to any unit of cultural transmission such as a song or an idea.

12 Dennett, D. C. *op cit* p 210

13 Dennett, Daniel C (1992) *The Self as a Center of Narrative Gravity*, in Kessel, F. and Cole, P. and Johnson, D., Eds. *Self and Consciousness: Multiple Perspectives* (Hillsdale, NJ: Erlbaum)

14 Lakoff, G and Johnson, M (1999) *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought.* (Basic Books)

15 J. Krishnamurti and David Bohm (1985) *The Ending of Time* (KFI: Madras)

Art and Archaeometallurgy of Nataraja: Exploring Visual Metaphors for Consciousness

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Nataraja and Visual Approaches to Consciousness

The 10th century Chola metal image of Nataraja from Tamil Nadu in southern India, which is often described as the 'Cosmic Dance of Siva' represents one of the most artistically acclaimed and widely known symbols of Indian culture, art and religion, which has invited the attention of artists, dancers, scientists and philosophers in India and the world over. Famous sculptor Rodin extolled the Nataraja in an essay 'La Danse de Siva' while Ananda Coomaraswamy in his exposition the The Dance of Siva (1924) described the image 'as poetry but none the less science'. This paper attempts to show that the Nataraja religious icon provides a unique historical case study in exploring perspectives from art and philosophy in attempting to not only arrive at an understanding of notions related to the consciousness and the cosmos, but also to thereby provide something of a visual metaphor for apprehending abstractions. Of course not all these metaphors were necessarily part of its original conception but it is interesting to note that there has been this process of accretion of symbolic meanings over time: in fact continuing right into modern times as clearly seen in the writings of physicists such as Capra (1974) finding parallels with modern cosmology in this medieval icon while Sagan (1980) saw in it 'a premonition of modern astronomical ideas'.

This paper also significantly points out that the symbolism associated with the Nataraja in some ways attempts to reconcile the duality of the inner space of the consciousness with the exterior space of the world or cosmos out there: which according to this author is in a way a concern that can particularly be traced back to the aesthetic sensibilities of the remarkable corpus of classic Tamil Sangam poetry (*c.* 3rd century BC-AD). A modern painting, 'Cosmic dance' by the well known Belge painter and Indologist Jean Letschert-Ascharyacharya who trained with the famed Belge Surrealist René Magritte indirectly captures these notions. The face of the Siva Nataraja in this painting is depicted in a way that is almost reminiscent of the transcendental calm of the Avalokitesvara painting in the Buddhist caves of Ajanta: depicting the inner space of the supreme consciousness outwardly radiating and manifesting itself in through dancing, swirling, patterns of cosmic blues and cosmic phenomena. A comment by Jean Letschert from his abstract submitted for this conference provides a useful contextual framework for this paper. He makes the point that we can derive two epistemological approaches to the understanding of consciousness, one that is essentially verbal and rational and the other that is basically visual, analogical and evocative, which is the realm into which Indian religious iconography essentially falls. In his essay 'A journey through vision' Jean-Letschert suggests that the symbolic dimension of works of art (which in his case are partly influenced by religious iconography and partly by Surrealism), come to life through an inner dimension of dynamic interactions between dream and reality, symbol and substance. The Nataraja, with its symbolic aspects is a very good example of such an evocative, intuitive approach to consciousness.

However, as far as this paper is concerned, what is addressed is more of a historical problem rather than the implications for consciousness research per se. Ananda Coomaraswamy (1924), drawing from 13th century Saiva Siddhantic texts had described the Nataraja icon as representing the *anandatandava* which he interpreted as the dance of bliss within the consciousness. Although it has been generally believed that such mystical connotations of the Nataraja icon came into prominence around the 13th century, when the worship of the Nataraja at Chidambaram came under more overtly Sanskritic influences (*chit*: consciousness and *ambaram:* cosmos), this paper instead argues that such notions were already in vogue by the 8th century Pallava period, particularly from the hymns of Tamil saints, such as Manikkavachakkar, and from astro-archaeological evidence while briefly reflecting on the role of Saiva Siddhanta rituals. In particular the influences going back to indigenous dualist concepts of Tamil Sangam poetics (*c.* 5th c. BCE-5th c. CE) exploring the interior space in relation to exterior space are explored, since consciousness is ultimately an awareness of the interior mindscape as being distinct from the world 'out there'.

Symbology of Nataraja's *Anandatandava*

Based on 13th century Tamil Shaiva Siddhantic texts such as Unmaivilakam composed at Chidambaram where the dancing Nataraja image is worshipped, Coomaraswamy interpreted the icon as Shiva's *anandatandava; (ananda:* bliss; *tandava*: Shiva's awesome dance), depicting the five acts or panchakritya, creation symbolised by the drum, destruction by the fire, protection by the front right arm, solace by the crossed left arm, dispelling of ignorance by trampling of the demon, with the ring of fire representing perpetual cosmic cycles of creation and destruction. Ananda Coomaraswamy (1924: 87) in his essay 'Dance of Siva' says: 'The dance in fact, represents His five activities (Pancakritya) viz: Shristi (preservation, support), Samhara (destruction, evolution), Tirobhava (veiling, embodiement, illusion and also giving rest), anugraha (release salvation, grace)...Unmai Vilakam, verse 36, tells us: 'Creation arises from the drum: protection proceeds from the hand of hope: from fire proceeds destruction: the foot held aloft gives release'. Coomaraswamy's notes go on as follows: 'The Supreme Intelligence dances in the soul...for the purpose of removing our sins. By these means, our Father scatters the darkness of illusion (maya), burns the thread of causality (karma), stamps down evil (mala, anava, avidya), showers Grace, and lovingly plunges the soul in the ocean of bliss (ananda). They never see rebirths who behold this mystic dance.'

Fritjof Capra in his Tao of Physics (1975) brought Nataraja into the global limelight and has brought into vogue another contemporary post-modernist symbolic dimension to this age-old image which has in its own way acquired a life of its own. Fritjof Capra wrote daringly that: "For modern physicists, then, Shiva's dance is the dance of subatomic matter...". A photograph in this book shows a shower of hundred particles produced in a cosmic ray shower which found its way into a bubble chamber by accident which left behind a dense series of downward parabolic tracks emerging from something like a single source. This visual is rather interesting in the way it is reminiscent the rear view of the flying matted locks of the dancing Siva issuing out of the head of Siva, as if they were both visual metaphors for the web of the 'cosmic consiousness' or 'supreme intelligence' extending or manifesting itself outwards from a single source into numerous directions.

Questions of Dates and Original Significance of Nataraja

From the historical perspective the question is relevant as to what the origins and original significance of the Nataraja metal icon were and the extent to which its formulation was really informed of a 'cosmic' or scientific comprehension. Coomaraswamy's 'cosmic' interpretations are not without problems as they derive from 13th century texts whereas the Nataraja icon is best known from the Chola period (10th-11th century). There have been other readings of the significance of the Nataraja as a political statement of the martial prowess of the Cholas (Kaimal 1999). The Tevaram hymns of Tamil saints to Nataraja (c. 6th-9th century) sometimes portray Siva as something of a social outcaste, even a madman wandering around cremation grounds: which can be interpreted as attempted subversion of the caste system and Brahmanical order which laid grounds for the Bhakti movement of salvation through intense devotion to a personal god rather than ritualistic worship.

There are also problems with the dating of the Nataraja icon itself. Since south Indian Hindu metal icons are rarely inscribed, there have been problems in stylistic dating which is done with respect to stone. For clarification, the Nataraja icon refers to the dance of Siva with the leg lifted across the hip in the specific dance pose known as *bhujangatrasita karana.*

The author's paper in World Archaeology journal (Srinivasan 2004) for the first time put forth comprehensive insights from archaeometallurgical, astro-archaeological and literary studies to suggest that the origins of the Nataraja metal icon goes back to the Pallava period (*c.* 800 AD) predating the Chola period (*c.*10th-11th century) that it is usually attributed to. The paper also briefly suggested that its formulation by this time was indeed nascently understood in terms of a 'cosmic' or metaphysical dimension by pointing to the significance of some examples of early Tamil poetry of the Saivite saints, *c.* 6th-9th century such as Manickavachakar (*c.* 9th century) and Appar (7th century).

Technology in the Study of Nataraja: Pallava Origins

Under the 10th-11th centuries Chola rulers, technology came to the aid of religion with the prolific casting of Hindu metal icons. Metal icons of Hindu deities were made in early medieval Tamil Nadu in southern India for being carried out in processional worship amongst devotees after being elaborately decorated. The worship of Siva, was propagated by Tamil Saivite saints of the 6th-9th century, while Siva Nataraja was the family deity or *kuladvata* of the Cholas. Several thousands of fine solid bronze images were cast by the lost wax process by skilled *sthapathis* or traditional icon makers, as still seen in Swamimalai. The stages of lost wax casting stage include the making of a wax model which is covered in clay to make mould and the mould is then heated and dewaxed and molten metal is poured in the mould to make the image. A great patron of Chola bronzes and temples was the Chola queen Sembiyan Mahedevi (*c*. 940 AD) under whom the first rounded stone Nataraja sculptures were made.

A technical finger-printing and authentication exercise on Chola and South Indian bronzes was undertaken by the author on around 130 images as reported in her doctoral thesis (Srinivasan 1996) which was the first such comprehensive study in the world. The sampling procedure used was of micro-drilling using a drill bit of no more than 1mm thick in inconspicuous parts of the icon to retrieve about 20-50 mg of sample and going to a depth of 1 cm into the main body of the icon, for instance, the armpit. The advantage that this technique had over the previous techniques is that it aided the analysis of bulk or interior composition while ensuring that sampling was undertaken with minimum damage to the artefact and the procedure was undertaken successfully even on very delicate artefacts in reputed collections including Victoria and Albert Museum (50), Government Museum, Chennai (70) and British Museum (10). Thereafter bulk compositional analysis was done using ICP-OES, i.e. inductively coupled plasma atomic emission spectroscopy with drillings being made into solutions for analysis. Major, minor and trace elements were analysed for 18 elements of Cu, Zn, Pb, Sn, Fe, Ni, As, Sb, Bi, Co, P, S, Cr, Mn, V, Cd, Ag. Another technique applied was lead isotope ratio analysis which is useful because the lead isotope ratios of leaded artefacts vary discretely according to the source of lead, providing for clusters of artefacts which have been similarly processed. Lead isotope ratio analysis was undertaken for sixty of the selected images (Srinivasan 1999). It was found that discrete metallurgical profiles could be indentified based on the trace element composition and the lead isotope ratios for different stylistic groups such as Pallava (7th-mid 9th century), Imperial Chola (late 9th-mid

12th century), Late Chola (mid 12th-13th century), Vijayanagara (mid 14th-16th century), Nayaka and Maratha (16th-19th century.

This technique validated the existence of Pallava bronzes as distinct from Chola which had been debated by historians. It was also found that Chola bronzes have a discrete metallurgical profile from Vijayanagar bronzes and from Late Chola bronzes. An example of a Pallava image whose dating was ratified by technical analysis is the

Kuram Natesa, Chennai Museum which was authenticated to the Pallava period (*c.* 7th century). A Pallava copper plate was found at Kuram lending weight to this. Interestingly, this study indicating that two Nataraja images which were previously regarded as 10th century Chola were in fact more likely Pallava based on the lead isotope ratio finger-prints. One of these is the Kunniyur Nataraja in the Government Museum, Chennai. Although this was thought to be 10th century Chola, technical finger-printing supports a Pallava attribution, ie. late Pallava, *c.* 800-850, in the most mature phase of Pallava metal casting.

Nataraja and the 'Cosmic Consciousness'

Archaeometallurgical and lead isotope studies by the speaker suggested a Pallava attribution (*c.* 8th century) for a Nataraja bronze from British Museum making it the earliest known Nataraja icon. The star chart for Orion was mapped onto this bronze in collaboration with astrophysicist Nirupama Raghavan which gave an excellent fit. This suggested that the Nataraja iconography was mapped around star positions like a wire frame (Srinivasan 2003) and suggested an intriguing 'stellar' inspiration for this bronze. The star, Ardra or Betelguese, in the constellation Orion is linked to the mythology of Nataraja with a chariot processional festival at the Nataraja temple at Chidambaram. The Nataraja temple at coastal Chidambaram in Tamil Nadu is the only site where a bronze Nataraja is worshipped in the sanctum, next to which is worshipped a curtained space representing Shiva as 'akasa lingam' or space. The idea of Nataraja's dance representing cosmic creation and destruction is well captured in the following 9th century hymn by Manickavachakkar (Dehejia 2003: 103):

> Let us praise
> the Dancer… (Kuttan)
> who sports
> creating
> destroying
> this heaven and earth
> And all else…
>
> – Manikkavachakar, Tamil, 9th century

Apart from the worship of Siva as *akasa lingam*, one of the meanings of the site name Chidambaram itself may be related to the idea of Siva as the cosmic consciousness (*chit:* consciousness; *ambaram:* cosmos) (Srinivasan 2001). Although it is generally thought it was through later 12th-13th century Sanskritic influences that the more beatific associations of the worship of Nataraja at Chidambaram came into vogue, linking the cosmos and the consciousness (Kaimal 1999, Younger 1995), according to the author there is evidence that such ideas were already a part of the Tamil tradition by the Pallava period predating later Sanskritic attributions, as seen in Manikkavachakar's 9th century verse (Yocum 1983: 20) which refers to the Tamil word *unarve* implying the one comprehension rather than the Sanskrit word *chit.* The terse and moving verse below conveys the idea of a supreme consciousness which is beyond the realm of ordinary words and comprehension as we understand it. It points to the way even words can fail to describe the indescribable which seems a real problem in the realm of consciousness studies, given that consciousness lies more in the realm of the felt, experienced, or even visually articulated, rather than that which can be described through language:

O unique consciousness *(or unarve),*
which is realised *(unarvatu)* as standing firm,
transcending words and (ordinary) consciousness *(unarvu)*,
O let me know a way to tell of You.

– Manikkavachakkar, 9th century, Tamil (22:3) ury, Tami

Saivite Agamic Rituals as Activation of the Consciousness

Temple practice in early medieval Tamil Nadu followed the Saiva Siddhantic canon of worship following the agamas. Indeed, the complex rituals prescribed in *agamic* worship related to the Siva and Nataraja can be seen as attempts and ways to negotiate the transition from a state of inertness (*jada*) to an animated state (*chit*) and the activation of the consciousness by imbibing Siva's nature which is itself consciousness. This is compared to the primeval act of striking fire from stones in this evocative translation of a passage from the Saiva Siddhantic text of Kamikagama (Davis 2000: 146): 'One should know that the divine glance distinguishes between what is inert (jada) and what is animate (chit) through Siva's own power of vision. Sprinkling upward renders an object suitable (for offering to Siva) by separating it from jada. Striking brings about the manifestation of cit in that object, as the striking of stones (manifest sparks) and sprinkling downward nurtures these sparks still more'. Davis (2000: 146) goes on to add: 'The transformation of normal food into naivedya, then, requires that the worshipper remove it from its normal status as inert matter and infuse into it the animating energy of consciousness. This process instills 'Siva-ness' into the substance since Siva's own nature is consciousness, and thereby makes it suitable for intimate contact with Siva'.

Sangam Literature Insights: Cosmos-Consciousness as Inner-Outer Space

This author would like to suggest that it is also relevant to keep in mind the early dualist Tamil poetic ethos to understand aspects of nature mysticism linked to worship of Nataraja and the linkage between the cosmos and the consciousness discussed above. Tamil Sangam poetry (loosely dated from about the 5th century BC-5th century AD) makes a separation between the akam genre (i.e. the intimate inner space of love and intimacy) and the puram genre (i.e. the outer space of the heroic and bardic). This recalls to dual aspects of Siva worship in Tamil Nadu, of the aniconic, unitary lingam (ie. cosmic pillar with phallic associations) in the intimate sanctum and of processional images outside, and of the invocation of Nataraja at Chidambaram as consciousness (inner space) and cosmos (outer space).

A.K. Ramanujan's translation of Tamil Sangam poetry as the example below from 'The Interior Landscape' (1967: 108-9) well illustrates this sense of traversing effortlessly from the interior mindscape of love to the exterior landscape of cosmic vistas, from the expansive macrocosm outside to the microcosm suggested by the world of the bees.

> Bigger than earth, certainly,
> higher than the sky,
> more unfathomable than the waters
> is this love for this man"of the mountain slopes
> where bees make rich honey
> from the flowers of the kurinci
> that has such black stalks.

In a similar vein, some of Manikkavachakar's 9th century verses written several centuries later also traverse the space from the exterior to the interior as for example the verse by Yocum (1984: 30) cited below which not only confirms the link between the worship of Nataraja and concepts related to *akam* or the inner space of the consciousness from Tamil Sangam poetics but also explains how this Indian tradition holds dance to be the most sublime way of experiencing and realizing this link and connection between inner and outer space.

He...revealed His foot which is like a tender flower,
caused me to dance
entered my innermost part (akam)
became my Lord.

Conclusion

The above analysis indicates that in many aspects the art, rituals and iconography of the Nataraja manages at subliminal levels to link the inner space of the consciousness with the exterior realm of the phenomenal world, providing extraordinary and highly contemporary visual metaphors for abstract and intangible concepts. In a historical sense this is a unique achievement of the religious artistic expression of medieval Tamil Nadu to the corpus of worldwide articulations on consciousness. It is found that Sangam concepts of interior mindscape and exterior landscape are a useful tool to explore the unique ways in which the ancient Tamil traditions, including Nataraja worship, emerged as a way of attempting to reconcile the dualities of the mind or consciousness inside and the cosmos or world outside.

References

Capra, F. 1976. The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism. London: Fontana, p. 258.

Coomaraswamy, A.K. 1924. The Dance of Siva. *The Dance of Siva - Fourteen Indian essays.* New York: Sunwise Turn, pp. 83-95.

Davis, R. 2000. *Worshipping Siva in Medieval India: Ritual in an Oscillating Universe.* New Delhi: Motilal Banarsidass Publishers.

Dehejia, V. 2003. Shiva-His Temples, His Images. In: Dehejia, V. (ed.) *The Sensuous and the Sacred: Chola Bronzes from Southern India.* New York: American Federation of Arts.

Kaimal, P. 1999. Shiva Nataraja: Shifting meanings of an icon, *Art Bulletin*, Vol. LXXXI, 3, 390-420.

Ramanujan, A.K. 1967. The Interior Landscape: The Interior Landscape: Love poems from a classical Tamil anthology. Oxford University Press.

Sagan, C. 1980. Cosmos. New York: Ballantine Books.

Srinivasan, S. 1996. *The enigma of the dancing 'pancha-loha' (five-metalled) icons: archaeometallurgical and art historical investigations of south Indian bronzes*. Unpublished Phd. Thesis. Institute of Archaeology, University of London.

Srinivasan, S. 1999. Lead isotope and trace element analysis in the study of over a hundred south Indian metal icons. *Archaeometry* 41(1).

Srinivasan, S. 2001. Dating the Nataraja dance icon: Technical insights. *Marg-A Magazine of the Arts*, 52(4): 54-69.

Srinivasan, S, 22 June 2003, 'Heritage: The Nataraja catapulted onto the global stage from sacred environs', The Week, Vol. 21, No. 29: 60-2. http://www.the-week.com/23jun22/life2.htm

Srinivasan, S. 2004. 'Siva as cosmic dancer: On Pallava origins for the Nataraja bronze'. *World Archaeology*. Vol. 36(3): 432-450. Special Issue on 'Archaeology of Hinduism.

Yocum, G. 1983. 'Madness' and Devotion in Manikkavachakar's Tiruvacakam. In: Clothey, F. and Long. B. (eds.). *Experiencing Siva: Encounters with a Hindu Deity*. New Delhi: Manohar Publications, pp. 19-37.

Younger, P. 1995. *'The Home of Dancing Sivan: Traditions of the Hindu Temple in Citamparam'*, Oxford: Oxford University Press, p. 112.

A Panel Discussion on "Consciousness, Experience and Ways of Knowing"

Panelists:
**NARAYANAN SRINIVASAN, RAMKRISHNA RAO,
SANGEETHA MENON, B. V. SREEKANTAN, C. S. UNNIKRISHNAN**

B.V. Sreekantan: I am not a philosopher, but an experimental physicist and why I got into thinking about consciousness is perhaps relevant. When I was reading the *mahavakyas,* the four famous sayings from the Upanishads, one of them says *prajnanam brahma,* i.e. consciousness is Brahman. What really set me thinking is, "Why is consciousness called Brahman?" and "What is the equivalence between consciousness and Brahman?" This led me to think of the parallelism in physics, about what is it that is common to everything that we see around us. As you go to deeper and deeper levels of investigations as a physicist, you end up with more questions. Newton himself did not know how the gravitational force goes from one end to the other. He knew how the intensity decreases but he did not know how the force is transmitted. It took almost three hundred years to bring in the ideas of quantum physics, quantum vacuum, fluctuations, virtual particles, creation, annihilation etc, to bring about some understanding. We started from explaining matter. Finally, we explain ultimate reality as some kind of substratum that is identified with quantum mechanical vacuum. Today we have to understand everything in terms of just one entity. This concept is not very different from the concept of Brahman and universal consciousness.

Ramakrishna Rao: I am glad that I am able to be here and participate in this conference. Considering the kind of feedback I received, the number of people who wanted to talk to me after the presentation was over, during the last two days, does suggest to me that there are a number of things that we all seem to share. We may not agree on the solutions and the answers but I think we all agree that we have discussed here some very fundamental issues, fundamental questions. The nature of consciousness itself is an issue that is too profound to be solved in a conference or in a set of conferences. In fact, consciousness, to my mind, is the most puzzling of all puzzles. I think it was William James who said, "The concept of self is the most puzzling of puzzles". But to me, even more primitive than the concept of self is the concept of consciousness and therefore it, to my mind, is the most puzzling of all the puzzles. As I sat and listened to the various speakers, somehow I was still thinking, what is consciousness, how can I describe it? I have attempted to study consciousness for a number of years, attempted to describe it, attempted to investigate it in a number of ways but always I was haunted by the apprehension that what I am talking about or what I am doing is probably not consciousness but something else. What is this thing called consciousness? How broadly can I look at this concept of consciousness? You can't look at it any broader than the notion of the Brahman, which is very encompassing, as Dr. Sreekantan has just pointed out.

To me, it looks as though the universe is an information system. All that exists, the reality, is nothing but an information system. So out of that information system you extract information. In the process of extracting that information, you bifurcate the system into two. And one is consciousness. It is the quintessence, it is the ground condition that makes it possible for us to retrieve information about things that exist. In so doing, you necessarily make a dichotomy, make a distinction between information and the thing to which this information relates. And this process of retrieving information takes place at different points in time at difference centers in the universe itself and consequently, we have the notion of individual consciousness or the person attempting to retrieve this information from a particular spot and this is the individual consciousness, but the whole thing is nothing but an information system. We are extracting that information. In order to do that, we have to have this basic, overall governing principle, which is the ground condition of all knowledge. That to me is consciousness.

But on the other hand, if you limit consciousness to any kind of a manifestation consequent to certain biological permutations and combinations, biological interactions of cortical processes, I think, we are missing the whole boat. We have to consider it in its larger perspective and that being it is the center, it is the essence, it is the basic ground for all awareness and that awareness can manifest as I said, in other ways, in a number of forms. I was able to think of four or five different forms but others can possibly classify them into more forms. All that becomes necessary inasmuch as the processing of information is itself a part of information and this is the tricky issue and this is probably the knot that we have to untie. Until we do that we shall continue to have the same conundrum, the same puzzle continuing to haunt us.

Narayanan Srinivasan: I am going to take an opposite route. The only thing we can be confident of is that we are conscious. So, I will start with humans. You don't have to define consciousness. It is very simple. If I show a circle on the screen and I ask you, 'What do you see?' then if you say it is a circle then I will say you experience a circle. It is not at all complicated.

You are unconscious of certain processing or information, whatever you want to call it or you become conscious of it. In my starting with the simpler approach, you are either unconscious or conscious of something. There are certain things you will not be conscious of at all. For example, some processing that is occurring in your retina, there is no chance that you probably will be conscious of it. It will be what we call an intermediate processing stage or intermediate representation. Just because a stimulus is there doesn't mean you will be aware of it. The simple issue is: You are unconscious of something. You can become conscious of it. The easiest way to think about it is to think of it as some sort of a threshold. If some concept or some information goes above the threshold, you are conscious of it.

Now, the question is: what's happening underneath? And that's one of the ways to study it. There are two other issues here. One is experience. When people ask me, 'Do you study experience?' I say, 'No.' I don't think you can study experience. What we study are relationships between experiences.

Another easy way to think about it is: think of the world. There are various things in the world. Put everything in a circle. There are lots of points. Think of your mind as another circle here. Everything, let us assume for simplicity has a corresponding thing inside the mind. You can link a red apple in the world as a representation in your mind. Now a red apple is related to the green apple in a certain way. The representation of the red apple and the representation of the green apple – how are they related to each other? In fact, when we do a psychological experiment in psychophysics, this is the question we ask. Our question is about the relationships between representations or relationships between experiences. When you understand all these relationships, you understand pretty much everything. We do experience. But all experiencing is always in relation to something else. Even when you say something is red, it is a relationship statement. For example, the same thing you will not perceive as red on some other day. It is always with respect to something. In this sense we have been studying consciousness for more than a hundred years.

The other point of view is that the only way we acquire knowledge is through interaction with the world. A lot of times it is not emphasized. We acquire knowledge only by interacting with the world. Our representations are created, destroyed, interchanged, transformed through interacting with the world. If you don't interact with the world, you will not acquire any knowledge. How we interact with the world will tell you about what sort of knowledge we acquire. It is a process.

C. S. Unnikrishnan: As a researcher, when you look at the physical world, it is not just studying the properties of the physical world. I certainly look at the physical world as a *rasika*. Who is a *rasika*? Even as a physics researcher you can be a *rasika* who looks at the world, its properties and so on. It is to look at how the world affects you not just intellectually but also emotionally. Part of my research has been quite involved with how the physical laws themselves are formed by the properties of the universe as a whole and how all natural laws are somehow fixed by various properties of the physical universe. When you involve very deeply into the properties of the universe, one realizes that what you get from that kind of a research tells you how inseparably you are linked to everything else in the universe. It is a physical link. But this is also a spiritual experience, as you can imagine. I don't want to go into the details of those kinds of research, but what one gets out finally from that kind of pure physics research is the outer harmonizing feeling.

Dealing with the physical world outside requires training, some aptitude for mathematics, physics and subjects like that and a sense for observation, respect for the physical world. You don't need so much courage though it certainly needs courage when you want to ask new questions. For example, people have asked me, coming from a small middle-class background from a small town in Kerala, how do I dare ask certain questions which I ask. I said, "No problem. In our culture a small child could go all the way to the God of Death and ask about the meaning of life after death. And with such profound questions being asked and recorded what's my problem? I don't need much more courage and motivation to ask these small questions". But to look inwards into consciousness requires a lot of courage because you don't know what to expect. In fact, you might change so much that you may not even be able to come back with your normal sense.

B. V. Sreekantan: Many think that consciousness is something like a software. But, what about the hardware? It is equally important. Unless you make hardware and software one and the same – what you are saying and what you are experiencing, there is no way science can finally answer for. Even the question of objective world and subjective world, distinctions we have made. You cannot call something objective *per se*, because you have only one experience, that is the experience within yourself. Even when you do an experiment it is what is happening in your own brain that is important. What is objective is of no use. I take a photograph of something, unless *I* interpret it, it is of no use. You can make it somewhat free of subjective biases. That is a different question. But ultimately, in terms of interpretation the difference between subjective and objective is purely one that is drawn for argument's sake and nothing else.

Sangeetha Menon: Unnikrishnan said that he has not experimented with inner experiences. When he qualified himself as a *rasika,* and he being a physicist, I was wondering what sort of experience would that be? Can a researcher see how the world influences him, not only by the physical laws but also emotionally? Narayanan Srinivasan said that defining consciousness might be a problem but it will be easier and clearer if we try to see what our basic sensory experiences are. Because, mostly we study relationships between experiences and not experience *per se*. We always experience in relation to something else. Ramakrishna Rao noted that we may not have all the answers but we have for sure discussed certain fundamental basic questions and to him it is important to take consciousness in a larger perspective. B. V. Sreekantan considers that the idea of universal consciousness, which is so dominant in Indian traditions is also an idea which is today very much reflecting in the developments of science.

We can see that these are four different perspectives, but four interesting and important perspectives. The idea behind this conference was not to give the final answer for the question 'what is consciousness', to judge 'what is real experience' and to say which way of knowing is the best way of knowing. This conference is meant to highlight the ideas that we think are important in areas such as science, philosophy, spiritual traditions and arts, and to extend our questions and imagination when we ponder over basic questions.

Can we extend our questions? Can we redefine our questions? Those attempts by themselves will be a major step in our progress towards understanding something very complex like consciousness and experiences, and to even understand how exactly we define the ways of knowing.

Abstracts of Lectures

Science, Reality and Consciousness

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A scientist as part of his daily and scientific activities has to get used to different kinds and different levels of reality. If he is given a flower, say a rose flower, what he recognises first are the beauty of the flower, the pleasing colour the fragrance or aroma of the flower and the softness of the petals – characterises which are real, but which he cannot quantify. When he takes it to the laboratory and looks under a microscope, he gets an entirely different picture of the flower. The particulate structure say of the petals, which through his knowledge of chemistry and physics he will trace successively to particular elements, and their molecules and atoms and the colour to the radiations from atomic transitions and so on. If he goes to a still deeper level of investigation he will be faced with yet another level of reality – the structure of atoms – the nuclei – the fundamental particles – the quarks and leptons He soon realises that according to current ideas of science everything around him and himself too are nothing but bundles of these fundamental particles. If he dares to go still deeper he will realise that these particles are just manifestations of quantum vacuum. All this knowledge – the fragrance, the softness on the one hand and the particles and the fluctuations of the quantum vacuum on the other cannot mean anything unless there is a consciousness to register, analyse, and interpret. What a neuroscientist can register with all his intricate equipment are only bundles of electrical signals and releases of neurochemicals in specific areas of the brain. How to relate these to the realities of the outer world or to the realities of the inner feelings? That is precisely what consciousness does. The neuroscientist has no explanation yet how this consciousness arises and how it operates. The views of some of the leading scientists on this question of reality will also be presented.

Consciousness and Cognitive Anomalies

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Consciousness refers to a complex set of apparently heterogeneous phenomena. These superficially diverse phenomena fall broadly into four categories - (1) primary awareness, (2) paradoxical awareness, (3) pathological awareness, and (4) paranormal awareness. They manifest in two forms- (1) the explicit and (2) the implicit. They appear to be governed by two fundamental processes - (1) the normal and (2) the paranormal, which do not constitute an incongruous dyad. It is suggested that they may be seen as mutually complementary processes.

The normal processes of awareness are those in which awareness is mediated by sensory processes, the nervous system and the brain. They admit naturalistic explanations within the framework of a physical system. The paranormal processes, however, resist such explanations calling for fundamentally different assumptions. In paranormal awareness there is no sensory mediation. The awareness is direct. The subject and the object have an identity relationship. The subject realizes the object in his/her own being by a process that may be appropriately termed *awareness by being*, distinguished from *awareness by knowing*. Awareness by being involves accessing pure consciousness. It leads to a state of awareness-as-such, a contentless and nonrepresentational state. Spontaneously on rare occasions and often by disciplined practice (if we may trust the yogic claims) a pure conscious event may manifest in a cognitively processed form. The mind as an interfacing instrumentality is involved in both the normal and paranormal processes. It is also the source of interplay between the two processes.

There are good reasons to believe in the reality of cognitive anomalies, collectively designated as "psi." Carefully conducted experiments and frequently reported spontaneous experiences provide persuasive evidence in support of ESP and PK, two forms in which psi seems to manifest. The known characteristics of psi suggest that psi involves a two-stage process. One of the stages is conceived to be something that may not be realized by a physical system. The other is normal cognitive processing. Inasmuch as psi thus involves normal and paranormal processes, it may be usefully thought of as a gateway between the two.

If ESP is real and can be investigated by deploying scientific methods, psi research may have profound conceptual, methodological and theoretical implications for consciousness studies and vice-versa. The fundamental distinction between awareness *by being* and awareness *by knowing* can play a crucial role in adding a new dimension to consciousness studies. It is important that researchers recognize that psi is one kind of awareness and that there is congruence and homogeneity among what at first appear to be a heterogeneous "hodgepodge" of disparate items of consciousness. Once there is such recognition, the researchers would begin to appreciate the important aspects in which they may benefit by learning how consciousness manifests at implicit and explicit levels and how the normal and the paranormal processes interact. An understanding of the interaction between the two would help to explain the subjective, "what it is like," experience and other aspects of consciousness that seem to defy physical explanations. As researchers learn more about the physical and psychological variables related to the occurrence of psi experiences, hopefully useful common ground between psi and other forms of awareness would be found.

Also, recognition of the reality of psi would take the wind out of the sail of state-central materialism and neural identity theories. Whether this necessarily leads us to favor radical dualism is, however, doubtful. A double aspect theory of the mind, which does not commit to either materialism or spiritualism, could account for all types of awareness including psi without the additional problems that radical dualism entails. Thus process dualism appears to be less problematic than entity dualism. Many classical Indian theories of mind consider the mind as matter in its subtlest form with normal and paranormal attributes. This line of thought deserves to be explored further with a naturalistic bias.

The Conscious versus the Subconscious: a View through the Neurobiology of Memory

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Some experiences are memorable, others forgettable. Most of us have to make a conscious and continuing effort to remember daily facts of life – phone numbers, names, dates, etc. While conscious or explicit memories of facts and events tend to fade away with time, memories of emotional events are often very powerful and persistent. For example, war veterans or victims of severe stress continue to have vivid flashbacks of traumatic events from their past, while their cognitive abilities diminish. Despite their best efforts, they are often unable to suppress traumatic Memories from their past. In other words, these people become victims of their subconscious emotions, which they are unable to control with their conscious, rational thoughts. Recent experimental studies in neuroscience may provide us with new insights into these complex mental processes. How does a particular experience leave its mark as a memory in the brain? For more than a century, the search for a biological basis of memory formation has centered on the synapse, the junction where information is passed from one brain cell to another. The remarkable ability of synapses to change in response to experience, a property described as "synaptic plasticity", is believed to mediate long-term storage of information in the brain. Memories of facts and events depend on synaptic plasticity in a brain structure called the hippocampus. On the other hand, emotional memories are processed by another structure called the amygdala. My laboratory is interested in understanding why memories of emotional events are often more potent compared to factual memories. To this end we study synapses, cells and microcircuits in the hippocampus and amygdala, by using a combination of behavioral, neuroanatomical, computational, genetic engineering and electrophysiological techniques. Using this strategy, we have identified several novel mechanisms which shed new light on the neural basis of the contrasting nature of conscious versus subconscious memories.

The Theory and Experience of Rasa

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Though the word 'Rasa' has many layers of meaning in Sanskrit, in the field of aesthetics, poetics and dramaturgy, it is invariably used as a term to designate the ultimate art experience.

Since Sage Bharata's *Nāṭyāsastra*, the word 'Rasa' has become the keystone in all facets of Indian art. According to Bharata, 'Rasa' is the product of the synthesis of *vibhāva* (stimulus), *anubhava* (responses) and *vyabhicāribhāvas* (transitory emotions). But, the riddle of 'Rasa' is not so simple. Hence, we have many theories to explain the same and these are inspired by several major schools of Indian philosophy, both realistic and idealistic. Among these, the theory of Abhinavagupta is the most acclaimed one and it is later further shaped and sharpened by the luminaries in Sanskrit poetics like Viśwanātha, Jagannatha, Karnapura and Madhusūdhanasaraswathi. Even the earlier theories of Lollata, Samkuka and Bhattanāyaka are known to us only because of the writings of Abhinavagupta. Of course, we have a host of other theories on 'Rasa' propounded by scholars like Bhojaraja, Rāmacandra and Gudnacandra, Bópadeva, Hémādri, et al. However, it is the school of Abhinavagupta which has stood the test of time and has won the acceptance of numerous scholars.

The present paper tries to explain the realization of 'Rasa', referring to the exposition of Abhinavagupta, Jagannātha and Madhusūdhana and also dwells upon the other theories briefly. While doing so, art experience as a whole, encompassing the areas of different basic arts will also be considered. Even the insights of great poets who existed before the said theories on 'Rasa' will be cited and discussed.

Living At The Edge Of Experience: The Way Of The Sanyasi

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The title derives from the claim made by the Sanyasis that their aim is to reach ultimate reality, which is beyond sense experience and the sadhana they are continuously engaged in, is the route to this existence.

For the last twenty years the author has been spending one month every year in the Himalayas, trying to interview Sanyasis who have left home in search of this ultimate reality. He has been looking at the life trajectory of the Sanyasis, the reasons for taking Sanyas, their relationship with God, Guru and the society they have left behind. A major focus in the interviews is on their Sadhana and their mental experiences when engaged in it. This paper will, while describing the whole study in some detail, focus especially on the sadhana techniques and the sadhana experience. The presentation will include a slide show of the places author has visited and the Sadhus he has interviewed.

Mandala Awareness in Indian Spirituality

Jean Letschert
Artist, Writer and Philosopher, Bangalore.

Being an extremely vast subject covering different levels of enquiry ranging from the material to the metaphysical, the investigations in the nature of consciousness quite often rely on initial insights which are then developed into a comprehensive systemic fashion. When we speak of insight it implies that one has to *see* something first before understanding it; and more specifically in a spiritual perspective one should see it with the eyes of the mind rather than with the physical organs of sight.

From this point of view, we can derive two major epistemological approaches to the understanding of consciousness: one that is essentially verbal and rational, the other that is basically visual, analogical and evocative. An all-comprehensive approach to the study of consciousness has therefore to take into account the complementarity of these two linguistic perspectives, treating them dialectically, with the purpose to enrich the mass of documentation available in view of a more holistic comprehension of the nature of consciousness.

To deepen our understanding of consciousness, it is a fact that we cannot do away with the various propositions and experiences the great spiritual traditions of mankind have made available to human knowledge, consciousness itself being the instrument *par excellence* of the presence of spirit in all aspects of life.

When tapping into the visual imagery developed by the great spiritual traditions of the world, we acknowledge that there is a recurring shape that is mysteriously common to most of them when they venture to depict the complexity of consciousness and which invariably tends to express one or the other form of symbiosis between unity and multiplicity, between spirit and matter, or any antinomy created in the rational and dualistic mind. This shape is that of a circle which contains a series of concentric circles vanishing successively towards an immovable center. These circles follow an evolutive and involutive process as they proceed towards the periphery or towards the center. The conventional name that has been given to this circular matrix and has entered into the spiritual vocabulary of the last decades is Mandala, a Sanskrit word which generically means a circular enclosure, and more specifically a circle drawn around a particular state of mind. Besides its obvious womb-like visual impact on the mind, further investigation raises fundamental questions regarding its origin. The foremost question in the context of consciousness studies may be stated thus: are Mandalas arbitrary confections related to cultural idioms or are they collective representations of a pre-existing archetype deeply cast within the structure of consciousness itself ? In other words, supposing we allow consciousness to express itself – to make a "self-portrait" of itself – wouldn't the Mandala be the first spontaneous form it will endeavor to formulate? Is there an inhering condition which could be termed "*Mandalic awareness*" which corresponds to the all-encompassing nature of consciousness and which could be instrumental, both in the scientific realm and the spiritual realm, to broaden our research and substantiate our aspirations for a holistic understanding of the subject.

Based on a series of visual documentation, this lecture will explore some of the relevant examples in Indian spirituality which are conducive to the understanding that there is a specific area in consciousness which generates an awareness of its all-inclusiveness.

The "Conscious" Bacterium

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Microorganisms are commonly perceived primarily as the causative agents of most contagious diseases that plague the humankind. This view gradually changed during the first half of the twentieth century, whereby, they began to be recognized as model organisms to study fundamental aspects of life processes. This gave birth to a new scientific discipline that we now call molecular biology. Recent studies have shown that bacteria are extraordinarily perceptive to their surroundings and can respond to changes in the most amazing ways. They can communicate with others and can collaborate as a group to mount elaborate behavioural responses to environmental challenges. The talk aims to examine some of these recent findings in the context of cognition studies on "higher" organism.

Brain and Being

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It is evident that neuroscience is a discipline that will influence our understanding of other minds and our own in a substantial manner in the years to come. The contributions from brain studies have today changed the way we address many a problem that required complex and challenging answers a decade or two back. Consciousness has inarguably become the most charming contender to walk the ramp for not just one but many allied disciplines that border neuroscience, cognitive psychology, neuropsychiatry, neurophilosophy and even biogenetics. Some say that the one area that will emerge in the coming years as the most important in the history of humankind is 'neuronomics', the nexus between neuroscience and genetics.

The meanings of human identity are certainly going to be debated in a manner that occurred never before. The evading character of consciousness makes it more appealing to almost all disciplines including the good old philosophy. But the fact of the matter is that even to have some minimalistic idea of what consciousness is, a whole set of parameters have to be factored in. This explains the rush of multidisciplinarity into the field of consciousness. What William James tried to capture, a 100 years back, in his epochal expression 'the stream of consciousness', has today given rise to many tributaries, and hence many bridges too. However, it seems that the two problems that will stay with us in the distant future are (i) the impersonal brain, and, (ii) the personal experience. Not to explain further, such a dual presents an apparent impasse. How can we even juxtapose the impersonal brain, a theory of which can explain all of human identity and why we do what we do; and the personal experience, without which all that we talk about consciousness become of no meaning?

Brain and Being seem to be the two inevitable dimensions of consciousness that mutually reinforce and challenge. This dual is not to be mistaken with a simple Cartesian dual or not even its avatar in Chalmersian theory. It is not even the easy and hard problem. What we are talking about is the fundamental nature of human experience. With a tiny snap in my brain I might see you in a manner that is most different. At the same time, with a reinforced sense of spiritual wellbeing, I can completely change the way I respond to the situation I am in.

It is extremely difficult to give away those human aspirations that constantly look for transformation, progress and wellbeing, however much neural become the explanations for these. Our being on one side is very much decided by those nanomaterials of our identity called neurons. But on the other side, we know that by positive approaches, by the route of the spirit and grace, by an insatiable urge to look for the beyond, we could make differences in our behavior, attitudes, relations and identities.

Brain is the key question for consciousness. But that question is meaningless without that which makes us a remarkable species: experience. Experience is directly related to the existence of agency. Today, the question of agency is considered vital for neuropsychological research, cognitive science as well as philosophical understanding. Another area where the issue of agency is central, but not discussed enough, is that of spiritual experiences.

Art and Archaeometallurgy of Nataraja bronzes: Explorations into Visual Metaphors and Consciousness

Sharada Srinivasan
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The 10th century Chola metal image of Nataraja from Tamil Nadu in southern India, which is often described as the 'Cosmic Dance of Siva' represents one of the most artistically acclaimed and widely known symbols of Indian culture, art and religion, which has invited the attention of artists, dancers, scientists and philosophers in India and the world over. The Nataraja religious icon provides a unique historical case study in exploring perspectives from art and philosophy in attempting to not only arrive at an understanding of notions related to the mind and consciousness, but also at thereby providing something of a visual metaphor for apprehending abstractions. In the 8th-10th centuries when the worship of the dancing Siva gained currency in the Tamil region, technology came to the aid of religion with religious fervour being spread through the building of temples and the casting of metal icons which were taken out in public religious processions. Archaeometallurgical investigations were made by the author on over a 130 south Indian metal icons sampled from major museums such as Victoria and Albert Museum, London and Government Museum, Chennai using lead isotope finger-printing, which suggested that the Nataraja bronze, depicting Siva dancing with the leg extended in the *bhujangatrasita karana*, was a Pallava innovation (7th to mid 9th century), rather than 10th century Chola as widely believed. Ananda Coomaraswamy, drawing from his interpretations of 13th century Saiva Siddhantic texts had described the Nataraja icon as representing the *anandatandava* which he interpreted as the dance of bliss within the consciousness. Although it has been generally believed that such mystical connotations of the Nataraja icon came into prominence around the 13th century, when the worship of the Nataraja at Chidambaram came under more overtly Sanskritic influences (chit: consciousness and ambaram: cosmos), this paper instead argues that such notions were already in vogue by the 8th century Pallava period, particularly from the hymns of Tamil saints, such as Manickavachakkar, and from astro-archaeological evidence while briefly reflecting on the role of Saiva Siddhanta doctrines, the influence of the philosopher Sankara and indigenous dualist concepts of Tamil Sangam poetics (*c.* 5th c. BCE-5th c. CE).

Meditation, Brain and Cognition

Narayanan Srinivasan and Shruti Baijal

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A major technique to produce an altered state of consciousness is meditation. The practice of meditation has a long history especially in India, China, Japan and other Southeast Asian countries. Meditation traditionally has been associated with Hindu and Buddhist religious practices. In the last fifty years or so, efforts have been made to study meditation as well as other altered states of consciousness using behavioural and physiological approaches. Questions have been raised whether meditative experience can be explained in terms of neural or cognitive processes. The current paper discusses empirical studies from cognitive science and neuroscience that have been performed on meditation. These studies show changes in neurocognitive processes and bodily states. The current EEG and brain imaging studies demonstrate significant changes in the brain due to meditation. Interdisciplinary approaches covering psychology, neuroscience, computer science and philosophy are further needed to understand meditation and its effects on brain and mind.

Scientific Investigation Of Psychoenergetic Phenomena: "Intention Imprinted Electrical Device" (IIED) Experiments Of William Tiller - A Brief Introduction

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During the last eight years Physicist & Materials Scientist, Dr. William Tiller, (Professor Emeritus of Stanford University), and his collaborators have carried out a series of path-breaking "psychoenergetic" experiments which seem to demonstrate that a group of accomplished meditators (typically four Siddha yoga practitioners) are able to consciously implant a "specific intention" into a special electronic device (actually an EEPROM connected to an oscillator circuit). A typical intention they use for example is for the electrical device to acquire the ability to "increase" (or alternatively "decrease") the pH of a bottle of ultra pure water kept a few inches from it. After the meditative implantation, which takes about 45 minutes, the "Intention Implanted Electrical Device" (IIED) is couriered by FedEx to a destination laboratory thousands of miles away where on placing it a few inches from a test flask containing pure water, its pH is found to steadily increase (or decrease as the case may be) by one full pH unit, over a one week period.

During such experimental campaigns, a phenomenon characterized by Prof. Tiller as "conditioning" of the laboratory, was accidentally discovered. They have since identified specific experimental signatures of such a "conditioned" space; Prof. Tiller is presently awaiting the grant of US patents for the experimental procedures which he claims can firstly produce and subsequently measure the "degree of conditioning" of any locale. Prof. Tiller's 2005 book (co-authored with Walter Dibble and J.G.Fandel) titled "Some Science Adventures with Real Magic" summarizes in great detail the rationale behind as also the results of his "robust" experiments. His earlier book "Conscious Acts of Creation - Emergence of a New Physics" (published in 2001) which has forewords by INSA fellows ECG Sudarshan and Rustum Roy, gives details of his initial experiments covering the period 1997-2000. Their five part paper published in the "Journal of Alternative and Complimentary Medicine" covering all these is available in their website www.tiller.org. These fascinating experiments have emboldened Tiller to extend Einstein's postulate of the equivalence of mass and energy to a third component namely consciousness. Tiller has also propounded a quantitative theoretical model which appears to explain not only his experimental findings but all Subtle Energy phenomena.

Denying Experience in the Physical World: Consciousness Misled

C. S. Unnikrishnan
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I explore how collective objective scientific knowledge of our times could be grossly off the mark because of the denial of experience and of the results of experiments (experience in situations specifically designed to gain experience) in particular. Such situations arise in the physical sciences due to efficient biasing of scientist's collective consciousness, generally thought to be immune to such bias, by specificities of theoretical descriptions, as well as due to factors of sociology, politics and even religion.

Human consciousness has no innate mechanism to sense truth, but gross misleading is countered by its capabilities in logical analysis. But it seems that this operates at a layer that could be veiled by more subjective considerations.

I explore these aspects in a case study related to the knowledge on motion and relativity. The situation in about 1905 regarding the analysis of motion and its physical effects had the options of retaining the notion of an absolute preferred frame or of its denial, leading to a theory of relativity without a preferred frame. The choice was made and retained by considerations that are not fully justified within the methodology of physical science. In any case, recent studies show that a large body of empirical experience regarding motion is treated without adequate logical analysis due to a collective hesitation to change the existing paradigm despite strong experiential evidence that point to the need to change the paradigm. The denial seems to go to the extent of denying even those aspects of the physical world that are directly sensible routinely where subjective experience does not conflict with objective collective experience.

The talk aims to demonstrate an instance where the collective scientific consciousness of the rigorous physical sciences displays surprisingly conservative and retrograde existence. This might serve as a good example how the powerful knowledge-seeking collective consciousness lags behind in its nonlinear path, whereas the limited individual surpasses such hesitation and goes beyond, as often happens in sciences.

Death and the Foundations of Science

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When human intelligence rose above that of animals, they began to fear the irreversible phenomenon of death. Primitive humans regarded it as temporary illness but later realized that it was a journey into the unknown. When their dead had to be buried to foil scavenging carnivores, intense feelings of claustrophobia were induced. Priests who were also counselors sought the fears of their flock by introducing religion with its philosophy. The abject fear of death however persisted and led men to seek the elixir of life through alchemy and their experiments to seek this *amruta* as well as to find the philosopher's stone to make gold laid the foundations of science. The exploration of nature was then reinforced by curiosity, a trait inherent in all animals.

The philosophies of the East, those of Hinduism and Buddhism, on the other hand, accepted death as a natural and temporary process wherein the soul returns to earth after a course of reprogramming. Based on the principle of *ahimsa*, not to cause suffering, *ayurveda* merely alleviated pain and never sought methods to cause immortality. As there was no incentive to avoid death, they neglected science and the search for eternal life. Instead they placed their trust in their divinities. The Moslem invasion and the advent of the colonists with their European belief in the power of logic brought about a revolution in scientific research and development in India and China.

Consciousness, Self and Metaphor

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Two thinkers who take an instrumentalist view towards folk psychological categories are Daniel Dennett and Goeorge Lakoff. Dennett's Multiple Drafts Model of Consciousness is an attempt aimed at attacking the ubiquitous 'Cartesian Theatre'. This results in viewing consciousness as the result of probing of one among the several narratives available to the cognitive processes. This has implication for the concept of self. For Dennett, the self is nothing but 'the centre of narrative gravity'. Lakoff attempts to build up a theory of mind based on the findings of cognitive science and argues that psychological categories are anchored on bodily metaphors. In the proposed presentation, I shall argue that the positions of Dennet and Lakoff can be developed in such a way as to bridge the gap between our scientific understanding of ourselves and the folk psychological theory of self. This can be a fruitful development of the project of third culture and helps in directing us towards, what J.Krishnamurti and David Bohm call, a remedial amnesia.

Attention, Awareness, and Knowledge: Implications of Change Blindness

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Strong claims have been made that attention is necessary for perception and we are only aware of the information we are attending.

Attention and awareness are almost always associated with each other. The studies of scene perception indicated that the representation of visual stimulus is quite accurate and we have the capacity to remember large number of scenes viewed just once. Studies of Iconic memory show that detailed representation of scene may be available though it disintegrates very fast. Evidences from Change Blindness (CB) studies contradict these findings and give insight of what might be the nature of representations of visual stimuli. CB studies indicate that attention is necessary for awareness and people are blind to changes to unattended objects when the transient due to the change is removed. Only those objects that are attended are preserved across saccades and there may be no such thing as a visually integrative buffer. Explanations of CB help in understanding the nature of visual short-term memory. It has been claimed that CB may occur because the information of previous stimuli is overwritten by new information. Experimental evidence also suggests that even though we are unaware of some information, we can use this knowledge to perform some tasks. Implicit learning and memory paradigms also support the availability of knowledge that a subject may not be aware of but can be shown to influence performance in certain tasks. For example, in CB experiments though explicit change detection rates are very poor, when presented with forced choice task observers performance was above chance level even when they reported being unaware of change. Sometimes they could recall information even though they had reported that they could not detect any change. Results from blindsight experiments also argue for the availability of knowledge without accompanying awareness. Further research is needed to fully understand the relationship between attention and consciousness as well as the type and extent of knowledge that one has about the world.

Cognitive Neuroscience of Altered States of Consciousness

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Consciousness is an important aspect of mind and various attempts have been made to explain consciousness and the phenomena associated with consciousness. One way of attacking this problem is to study certain "changed" or "different" states of consciousness called as the altered states of consciousness (ASCs) that would itself reveal something about normal states of consciousness. ASCs range from typical human experiences like dreaming to atypical experiences like hypnosis. ASCs can result from intense personal effort (meditation, tantra, ecstatic dancing, and sensory deprivation) or through external agents (drugs, hypnosis). ASCs are also produced under disease conditions including various psychotic disorders like Schizophrenia as well as coma and vegetative states. Other controversial ASCs include out-of-body and near death experiences. Given the large variety of ASCs, it is important to investigate the similarities and differences between these states. Recently cognitive scientists and neuroscientists have started exploring these ASCs by using behavioural and neural approaches. Specifically cognitive electrophysiology (EEG/ERP) and neuroimaging has been used to investigate some of the neural correlates of ASCs. These techniques have demonstrated changes in brain activity due to changes in the states of consciousness that differ from the normal state of consciousness. Thus, it provides a way of measuring changes in cognitive functions due to changes in these states and correlating it with the normal states of consciousness. It has been proposed that these ASCs are the result of dynamical and constantly interacting neural activities between cortical and sub-cortical regions. Further research and modeling of brain function may help determine the concomitants of ASCs. Thus, interdisciplinary approaches covering psychology, neuroscience, computing and philosophy are further required to explore and approach towards solutions to the problem of consciousness.

Epistemic action: A Link between Consciousness and Extended Mind?

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In this paper, we introduce and discuss the general idea of epistemic action, introduced by Kirsh & Maglio (1994). Epistemic actions are actions an agent performs primarily to gain knowledge — it is an action that contributes to computation. An example would be rearranging rummy cards so that the set possibilities can be "read-off" the hand, and not computed repeatedly. Epistemic actions are contrasted with pragmatic actions, which are actions executed primarily to alter the physical task environment. Epistemic actions make mental computations easier, faster and more reliable.

Various phenomena have been investigated using the framework of epistemic actions. Mental rotation is one example where performing an actual rotation in the world is shown to be sometimes more advantageous than performing a mental rotation, especially in dynamic games like Tetris. At the very least, epistemic actions show the importance of actions in perception, awareness and knowledge acquisition.

Epistemic actions question the view that the mind resides entirely within the body, and raises the case for an 'extended mind', as argued for by Clark and Chalmers (1995). According to this view, any component of the world that plays the same role as that of any brain/body component in the cognitive process would count as "mind". Thus cognition is viewed as outcomes of complex cognitive systems with social/institutional/artifactual components. Individual cognition is viewed as one component of such a system.

But, what of consciousness? Many identify cognitive with the conscious, and it seems far from plausible that consciousness extends outside the head. Are the first-person aspects of mind then to be exempted from the extended-mind theory? One of the replies is that the inner phenomenological awareness cannot be lost within the environmental embedding. We therefore see epistemic action as a link between perception (awareness) and knowledge acquisition.

References

1. Kirsh, D. & Maglio, P. (1994). On distinguishing epistemic from pragmatic action. *Cognitive Science*, *18*, 513-549.

2. Clark, A. & Chalmers, D. (1998). The Extended Mind, *Analysis*, *58*, p.7-19.

Hold your nerve

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Narratives restore harmony in the noise of life. In fact, one of the major themes of human life where this noise is quite glaringly visible is when humans battle with mental deficits. Medicine explains such deficits through the neurological anatomy covering the nervous system including the brain. And, the study of these two internal structures leads to neurology, which is extending well into a broader discipline called neuroscience. In both these dazzling fields, there have been several specialists who surpass their clinical constraints to produce scintillating narratives. I wish to study the works of two engaging neurologists of the 20th century.

The preeminent neuropsychologist Alexander Luria, and largely inspired by him, the renowned neuroanthropologist, Oliver Sacks – Both of them have transformed their patient's neurological diagnoses into wondrous narratives. Energized by real-life situations, these narratives nourish a novel way to document neurological complaints. Luria and Sacks aspire through these narratives to preserve the identity and dignity of the human self.

By moving beyond mere chronicling of the case histories, these neurological narratives trounce the prevalent gross reductionism of the brain and help enrich the existential sanity of humanity.

Specifics: I would select few neurological deficits (some result in advantages too) and briefly describe how they impinge on consciousness and impact the current literature about the subject. Useful illustrations and cartoons may invade the text.

List of Speakers and Brief Biography

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Dr. Krishnaswamy Kasturirangan is presently the Director of the National Institute of Advanced Studies (NIAS) at Bangalore and the Hon'ble Member of Parliament (Rajya Sabha). Dr. Kasturirangan has steered the Indian Space programme gloriously for over 9 years as Chairman of the Indian Space Research Organisation, of Space Commission and Secretary to the Government of India in the Department of Space, before laying down his office on August 27, 2003. He was earlier the Director of ISRO Satellite Centre, where he oversaw the activities related to the development of new generation spacecraft, Indian National Satellite (INSAT-2) and Indian Remote Sensing Satellites (IRS-1A & 1B) as well as scientific satellites. He was also the Project Director for India's first two experimental earth observation satellites, BHASKARA-I & II and subsequently was responsible for overall direction of the first operational Indian Remote Sensing Satellite, IRS-1A. Dr. Kasturirangan took his Bachelor of Science with Honours and Master of Science degrees in Physics from Bombay University and received his Doctorate Degree in Experimental High Energy Astronomy in 1971 working at the Physical Research Laboratory, Ahmedabad. Under his leadership, as Chairman, ISRO, the space programme has witnessed several major milestones including the successful launching and operationalisation of the India's prestigious launch vehicle, the Polar Satellite Launch Vehicle

(PSLV) and more recently, the successful conclusion of flight testing leading to operationalisation of the all important Geosynchronous Satellite Launch Vehicle (GSLV). Further, he has also overseen the design, development and launching of the world's best civilian satellites, IRS-1C and 1D, realization of the second generation and initiation of third generation INSAT satellites, besides launching ocean observation satellites IRS-P3/P4. These efforts have put India as a pre-eminent space-faring nation among the handful of six countries that have major space programmes. As an Astrophysicist, Dr. Kasturirangan's interest includes research in high energy X-ray and gamma ray astronomy as well as optical astronomy. He has made extensive and significant contributions to studies of Cosmic x-ray sources, celestial gamma-ray and effect of cosmic x-rays in the lower atmosphere. Dr. Kasturirangan is a member of several important scientific academies, both within India and abroad. He is presently, President of Indian National Academy of Engineering, Chairman of the Council of the Indian Institute of Science and Raman Research Institute at Bangalore and of the Governing Council of Aryabhatta Research Institute of Observational Sciences at Nainital.

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Jean Letschert Ashcharyacharya is born in Brussels, Belgium, in 1939. After graduation in architecture and monumental painting from the Royal Academy of Fine-Arts of Brussels in 1958 he undertakes a carrier as a painter, decorator and illustrator. At the age of 22 he discovers the teachings of Ramakrishna Paramahamsa and Vivekananda, and develops a deep interest for Eastern Spirituality, meets Jiddu Krishnamurti in Switzerland and becomes deeply involved in his teachings. Dr. Jean Letschert Ashcharyacharya has resided in South India for more than 30 years. Since December 1999, he is residing in Bangalore, Karnataka, where he has become a significant personality in the realm of culture. He has authored three books in French on Indian spirituality among which a translation with commentaries of the main Upanishads. He has written several articles on similar subjects for European revues. For the past 5 years he is currently working on what he considers should be his master-opus : a book with a visual rendering of the 100 shlokas of Shankaracharya's SAUNDARYA LAHARI, with his own translations and commentaries. Due to his eclectic personality and his wide range of interests, his activities cover a variety of fields: Symbolist artist, environmental designer, art therapy & meditation consultant, writer, lecturer, philosopher, Indologist and Sanskrit translator. As an exponent of the philosophy of Advaita Vedanta, his teachings are oriented towards the actualization of the Whole Person, involving psychology, ethics and practical aesthetics in all aspects of life. He considers himself as a genuine ambassador of the perennial spiritual culture of India.

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Sangeetha Menon is a philosopher with a doctorate awarded for the thesis entitled "the concept of consciousness in the *Bhagavad Gita*" a major text of Indian philosophy. After graduating in zoology she took her postgraduate degree in philosophy and Ph.D from University of Kerala. A gold-medallist and first-rank holder for postgraduate studies, she received University Grants Commission fellowship for her doctoral studies for five years. She is working as

Fellow at the National Institute of Advanced Studies since 1996. Dr. Menon has been working in the area of consciousness studies for over fifteen years. She has given numerous lectures and presentations at various national and international forum on consciousness, spiritual and aesthetic experiences, and science-spirituality interface issues. The *Journal of Transpersonal Psychology* published an article on her research work and significant contributions (2002). Dr. Menon has co-edited three books on "Science and Beyond: Cosmology, consciousness and technology in Indic traditions" (2004, NIAS), "Consciousness and Genetics" (2002, NIAS) and "Scientific and Philosophical Studies on Consciousness" (1999, NIAS). Her book "Dialogues: Philosopher meets the Seer" (2003, Srshti Publishers) is a set of nine dialogues with her Guru on socio-cultural issues of contemporary importance. She has several publications in peer-reviewed journals, and contributed chapters on a variety of issues relating to self, mind and consciousness. She has also authored few monographs on consciousness in the context of Indian thought. She has been awarded two national awards and one international award for her achievements in the field of consciousness and Indian philosophy and psychology. In 1988 she was awarded the "Swami Pranavananda Philosophy Trust of India Award". In 2003 she was awarded the "Young Philosopher Award" for her research work from Indian Council of Philosophical Research. This is the topmost national award given to a philosopher belonging to her age group. Recently (2005) she won the international award entitled "Global Perspectives on Science and Spirituality Award" (www.uip.edu/gpss) and is currently writing a book on relating 'consciousness, agency and spiritual experience'. She is an avid photographer, artist and web-designer.

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Sharada Srinivasan has made significant contributions in the field of archaeometallurgy, i.e the study of metallurgy in relation to history, conservation science and scientific applications in art history, archaeology and museum studies. For the past four years, she has been based at the National Institute of Advanced Studies, Bangalore (2001-4) and has previously held a Homi Bhabha Fellowship at the Department of Metallurgy, Indian Institute of Science (1996-8). Dr. Sharada Srinivasan has 10 years research experience since the award of Phd. (from Institute of Archaeology, University College London, Department of Conservation and Material Science) as an internationally and nationally reputed scholar with well cited published works including a book and 23 research papers and has also done a research associateship at the Department of Conservation and Scientific Research at the Freer and Sackler Gallery, Smithsonian Institution, USA. She is a recipient of prestigious awards such as the Malti B. Nagar Ethnoarchaeology Award (2005), the Materials Research Society of India Medal (2006), India Foundation for Arts, Arts Documentation Award (2003), the Flinders Petrie Medal 1989 from University of London, the Materials Research Society Graduate Student Award 1996 and the DST-SERC Young Scientist Fellowship. Her doctoral thesis research at Institute of Archaeology, University College, London on archaeometallurgical investigations on south Indian metal icons in the Victoria and Albert Museum, London and Government Museum, Chennai was the first to have extensively made use of lead isotope analysis in the study of south Asian archaeology and art history. She has important original archaeometallurgical findings pointing to the accomplishments of ancient Indian metallurgists including production sites of high-grade wootz steel, evidence for the use of skilled alloys such as high-tin bronzes to make vessels and mirrors, and the extractive metallurgy of copper and bronze. Her investigations have demonstrated the usefulness of a range of analytical and metallurgical techniques in archaeology such as lead isotope analysis, spectrochemical and ICP analysis, SEM, EPMA-EDAX etc. A B.Tech from Indian Institute of Technology in Engineering Physics, Dr. Srinivasan also has significant inter-disciplinary expertise with a background in art history (with an MA in Art and Archaeology from School of Oriental and African Studies, London). Dr. Srinivasan has lectured widely at international and national venues and teaching institutions (eg. UK, USA, Sweden, Japan, Sri Lanka, China) and has been guiding international doctoral candidates.

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Mrinalini Sarabhai, the celebrated dancer and choreographer, has achieved an international reputation that is unmatched by any contemporary Indian classical dancer. The syntax of her creativity mediates between a moral commitment to traditional form and the desire to claim one's own experiments as unique, unrepeatable. This interface of technical mastery and creative expressionism achieves a profoundly versatile language of the body - simple, eloquent, visually inspiring. The creative anarchy of her essentially modern style is convincingly disciplined by the taut orthodoxy of her classical technique, learnt from her guru Sri Meenakshi Sundaram Pillai. The result is an exalted visual statement combining almost fanatical purity of vision with modish formal experiments. She is the founder-director of the Darpana Academy of Performing Arts, Ahmedabad, which came into being in 1949. She has travelled extensively all over the world and has received many distinguished national and international awards and citations for her contribution to the preservation of Indian classical dance. Called "the High Priestess of Indian dance" by dance critics, she is a pioneer in creative work and has given "new concepts to traditional dance forms with fresh perspectives and new mysteries." She has many publications to her credit. She is the first Indian to receive the medal and Diploma of the French Archives Internationales de la danse. She was awarded the title of Natya Kala Sikhamani in Madras in 1960 in recognition of her artistic eminence and her unequalled performances of Bharatanatyam. In 1965, she was awarded the Padma Shri by the Government of India.

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Narayanan Srinivasan is mainly interested in studying visual perception and attention, consciousness and computational modelling of cognitive processes. He did his Masters degree in Electrical Engineering from Indian Institute of Science and the Master's project was on EEG signal processing. During his doctoral work at University of Georgia with Dr. James Brown, he has looked into the interaction between attention and spatial frequency processing. He did his postdoctoral work at University of Louisville with Dr. Edward A Essock on diagnostic algorithms for Glaucoma. At CBCS, he is pursuing various research projects on visual attention, consciousness and computational modelling. We are currently looking at processes associated with object-based attention, attentional processes in normal children and children with ADHD, change detection, and processing with hierarchical visual stimuli. We are also working on computational models of cognitive processes. At present, we are focusing on a graph theory based model for identifying phonological jokes, hindustani music analysis looking at raga recognition, and modelling visual attention. We are also conducting an EEG study to explore brain activity during meditation.

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Nataraja Sarma was educated at Madras Christian College, Unviersity of Madras; Emmanuel College, Cambridge UK an the Imperial college, London. At the Bhabha Atomic Research Centre Dr. Sarma did basic research in nuclear and high energy physics and on the enhancement of precious stones. He has published 136 research papers in physics, two on ancient astronomy in Endeavour, and many articles on science in newspapers and magazines in India and elsewhere.

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Farah Naaz is currently doing my M.Sc. in Cognitive Science at the Centre for Behavioural and Cognitive Sciences, Allahabad University. She has completed her B.Sc with Botany and Zoology from Allahabad University. She is generally interested in the topic of Perception, Attention and Awareness. She is working on the topic of Change Detection as her Master's Thesis. This project aims at studying various factors that affect our ability to detect change.

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Shruti Baijal is presently a Master's student at the Centre for Behavioural and Cognitive Sciences at the University of Allahabad. Before joining the Master's programme She did her undergraduate degree in Zoology (with Honors) at the University of Delhi. She hhas always been interested in Neuroscience and Cognition which led her to take up a research project on the neural bases of altered states of consciousness (meditation). Besides this, she is interested in studying Attention and Cognitive Neuroscience.

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Dilip Athreya was born and brought up in Bangalore. He has done Bachelors of Science (Mathematics, Electronics and Computer Science) from Bangalore University. Currently he is in 2nd Semester of Masters Degree in Cognitive Science from Center for Behavioral and Cognitive Science, University of Allahabad. His interest has a wide spectrum from dramatics to science of mind to philosophy. In the realm of Cognitive Science he is interested in visual perception, particularly *Imagery*. He would like to work with nonlinear dynamical approach to cognition in future. *Imagination* and *Illusion* are the two mysteries that he would like to dig upon and demystify. He is also interested in Indian philosophical approach to cognition and perception, especially Sankara's Advaita philosophy.

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Sharat Shastri's graduate and postgraduate education in science swung him between certainty and ambiguity until he chanced upon literature and philosophy, which reinstalled much-needed curiosity for knowledge. And, he got a lifetime task: to become what he is potentially capable of. As a first step, he joined for a postgraduate course in English at CIEFL, Hyderabad. Fortunately, he had the privilege to be tutored by some brilliant professors who touched him with their compassion and ingenuity. Synthesis of disciplines by trying to weave a rainbow out of diversities has moved him through various subjects. In this pursuit, he have had the impressive company of some bright minds to prepare for research to blend one of the most enlivening disciplines: literature & philosophy with an equally enthralling subject: medicine (especially neurology, neuroscience.). He is gradually learning and he wishes that through this august conference, he can explore and discover new pathways to knowledge.

Conference Programme

Monday, 6 February 2006

9.30 AM	*Welcome and Opening Remarks*
	K. Kasturirangan Director, National Institute of Advanced Studies
	Introduction
	Sangeetha Menon National Institute of Advanced Studies
	Registration: 9-9.30am
	Session 1: Chair – C. S. Unnikrishnan
9.45 – 10.15	**B. V. Sreekantan** on *Science, Reality and Consciousness*
10.15 – 10.30	DISCUSSION
10.30 – 11.00	TEA/COFFEE
	Session 2: Chair – Nataraja Sarma
11.00 – 11.30	**K. Ramakrishna Rao**: *Consciousness and Cognitive Anomalies*
11.30 – 11.40	DISCUSSION
11.40 – 12.00	**M. Srinivasan:** *Intention Imprinted Electrical Device: Experiments of William Tiller*
12.00 – 12.10	DISCUSSION

	Session 3: Chair – Narayanan Srinivasan
12.10 – 12.30	**S. Mahadevan:** on *The "Conscious" Bacterium*
12.30. – 12.40 PM	DISCUSSION
12.40 – 1.00	**Sumantra Chattarji** on *The Conscious versus the Subconscious: A View through the Neurobiology of Memory*
1.00 – 1.10	DISCUSSION
1.10 – 2.00	LUNCH
	Session 4: Chair – K. Ramakrishna Rao
2.00 – 2.20	**Jean Letschert** on *Mandala Awareness in Indian Spirituality*
2.20 – 2.30	DISCUSSION
2.30 – 2.50	**Shatavadhani R. Ganesh** on *The Theory and Experience of Rasa*
2.50 – 3.00	DISCUSSION
	Session 5: Chair – B. V. Sreekantan
3.00 – 3.20	**C. S. Unnikrishnan** on *Denying Experience in the Physical World: Consciousness Misled*
3.20 – 3.30	DISCUSSION
3.30 – 3.50	**Nataraja Sarma** on *Death and the Foundations of Science*
3.50 – 4.00	DISCUSSION
4.00 – 4.30	TEA/COFFEE

4.30 – 6.00	Session 6: **Poster Presentations:** **Shruti Baijal** on *Cognitive Neuroscience of Altered States of Consciousness* **Farah Naaz** on *Attention, Awareness, and Knowledge: Implications of Change Blindness* **Sarat Chandra** on *Hold Your Nerve*

Tuesday, 7 February 2006

	Session 7: Chair – K. Ramakrishna Rao
9.45 – 10.15 AM	**R. L. Kapur** on *Living at The Edge of Experience: The Way of The Sanyasi*
10.15 – 10.30	DISCUSSION
10.30 – 11.00	TEA/COFFEE
	Session 8: Chair – R. L. Kapur
11.00 – 11.20	**Narayanan Srinivasan** on *Meditation, Brain and Cognition*
11.20 – 11.30	DISCUSSION
11.30 – 11.50	**Sangeetha Menon** on *Brain and Being*
11.50 – 12.00	DISCUSSION
12.00 –1.00 PM	Session 9: **Poster Presentations** **V. Harinarayanan** on *Consciousness, Self and Metaphor* **Dilip Athreya** on *Epistemic Action: A Link to Consciousness in Extended Mind*

1.00 – 2.00	LUNCH
	Session 10: Chair – Sangeetha Menon
2.00 – 2.45	Special Lecture (and *abhinaya*) *by* **Mrinalini Sarabhai** *on The Concept of Beauty in Indian Aesthetics*
2.45 – 3.00	DISCUSSION
3.00 – 3.30	TEA/COFFEE
	Session 11: Chair – Sangeetha Menon
3.30 – 3.50	**Sharada Srinivasan** on *Art and Archaeometallurgy of Nataraja Bronzes: Explorations into Visual Metaphors and Consciousness*
3.20 – 3.30	DISCUSSION
3.30 – 4.30	Session 12: **PANEL DISCUSSION** on **"Consciousness, Experience and Ways of Knowing: Perspectives from Science, Philosophy and the Arts"** Chairperson : Sangeetha Menon Panelists : B. V. Sreekantan K. Ramakrishna Rao Narayanan Srinivasan C. S. Unnikrishnan
4.30 – 5.15	**OPEN DISCUSSION**
5.15 – 5.30	CONCLUSION

Today often the issue that gathers focus inspite of its evasive nature, in discussions on consciousness, cognition, or even advancements in nanotechnology and biotechnology, is about *Experience* with a capital 'E'. The last few decades have seen tremendous achievements in creating new technologies and theories to understand life, nature and universe. This has brought back the human factor into discussions. In this book, authors address the persistent puzzles in consciousness studies, developments in cognitive sciences, and the distinct ways of knowing and experiencing in science, philosophy and the arts in the context of the Indian discourse. It is hoped that this discussion will help to examine the emerging trends in these areas and also explore the place of 'experience' in knowledge and belief systems.

About NIAS

The National Institute of Advanced Studies was conceived and started by the late Sri J. R. D. Tata. Sri Tata was desirous of starting an Institute which would not only conduct high quality research in interdisciplinary areas but also serve as a medium which would bring together administrators in the government and private sector with members of the academic community. He believed that such an interaction could be of great help to executives in their decision making capabilities. NIAS is situated in the picturesque Indian Institute of Science Campus in Bangalore. Its faculty is drawn from different fields representing various disciplines in the natural and social sciences. The Institute carries out interdisciplinary research and is unique in its integrated approach to the study of the interfaces between science and technology and societal issues. Dr. M. S. Swaminathan is the Chairman of the Council of Management of the Institute. Dr. Raja Ramanna was the Director since its inception till his retirement on July 31, 1997. Prof. R. Narasimha was the Director from 1997 to March 2004. Dr. K. Kasturirangan, (Hon'ble Member of Parliament, Rajya Sabha), former Chairman, ISRO, is currently the Director of the Institute.

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