Quite a few winters back, while strolling in the Natural History Museum of London I chanced upon an exhibition that was simply called “Who am I?” Quite a leading question, that. And like everyone around me, I was curious. What followed was a series of revelations from tracking my ancestral records to giving me a macro perspective of the being – genetically, physically, culturally, biologically and philosophically. It was a journey at multiple layers.

Just a couple of summers back, four of us friends – a Hindu from India, a Christian from Pakistan, a Muslim from Bangladesh and a Buddhist from Sri Lanka – were musing about life, cultures and consciousness sitting on the sidewalls of the Sawayambhunath Temple in Kathmandu, as the beautiful cityscape lit up under us. At that very moment, as if by magic, we suddenly realised our descents and the amazing variety we represented in just four bodies – two male and two female. The moment was captured for posterity with a self-timer and lovingly captioned ‘Four Idiots’ owing to the preceding conversation that revealed how little we knew of each other. And how much always remains to be known despite our best efforts.

It is this overwhelming mélange that an interdisciplinary study such as consciousness brings to the table. From the abstract to the theoretical, from birds and bees to chimpanzees and fish, spanning smells, sights, sounds, perceptions and disorders – the canvas is simply breathtaking.

The International Conference on Consciousness, Cognition and Culture: Implications for the 21st Century is all set to celebrate this diversity. Not just through scientific studies and mathematics that unlock the brain’s many computer-like wares and vice-versa, but also by taking a peek into the philosophical, traversing the mystic, peering into religion and finding deeper meaning in poetic devices.

The conference, which will bring together some leading names in consciousness studies from across the world, is hoping to meander effortlessly between philosophy of psychology and neuroscience and from the concepts of punishment and reward to neuro-medicine.

Nature India, a showcase of India’s science, is proud to be associated with such a mixed-bag conference as its media partner.
Consciousness is one among the frontiers of human enquiry for both science and philosophy. Understanding consciousness has implications not only on academic progress but also on outcomes that would influence human thinking, well-being and culture. The challenge of consciousness studies is that, on one hand, it brings together many disciplines heralding interdisciplinary and transdisciplinary studies, and on the other hand, attempts to provide topology maps with qualitative and quantitative understandings. Consciousness research promises to deliver significant contributions to emerging disciplines such as medical humanities, brain-computer interfaces, philosophy of psychiatry and psychology, etc. A fundamental enquiry is to discover the brain wirings to find the mysteries and complexity of consciousness and human experiences.

India is the land of pluralistic thinking and experiences, with diverse classical philosophies and cultural engagements. We have a lot to offer to the academic world, and different ways to understand consciousness and human mind, derived from ancient wisdom traditions of our country as well as from the cultural richness combined with current strengths of theoretical and experimental sciences. I welcome all participants from India and the rest of the world to the National Institute of Advanced Studies. I am confident that you will enjoy and be enriched by the deliberations of the conference. I do hope that you will return as fulfilled person with many more new questions to ask, many research areas to investigate and more importantly, many more friends and possible collaborations for future.

The international conference on “Consciousness, Cognition and Culture: Implications for the 21st Century” organised by the NIAS Consciousness Studies Programme, is an outcome of long standing interest and focus domain of this Institute. It is yet another expression of the vision of the Founder of NIAS, the late Mr JRD Tata, to bring together humanities, arts, social sciences and natural sciences towards understanding current and forthcoming complexities and challenges. The conference brings to us the best minds around the world to speak to us on consciousness, cognition, self and their interfaces. This event also provides abundant opportunities for young students and faculty members to explore further and get updated with the latest concepts and pathways of thinking in this fascinating interdisciplinary domain.

I wish you an engaging time and bliss at the conference in Bengaluru and in India.

With my best wishes and personal regards,
Baldev Raj
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About the National Institute of Advanced Studies

National Institute of Advanced Studies (NIAS) was conceived and founded in 1988 by J. R. D. Tata, who sought to create an institution to conduct advanced multidisciplinary research. Housed in a picturesque green campus in Bengaluru, the Institute serves as a forum to bring together individuals from diverse intellectual backgrounds — including administrators and managers from industry and government, leaders in public affairs, eminent individuals in different walks of life, and the academicians in the natural and life sciences, humanities and social sciences.

The philosophy underlying NIAS is given shape by its research teams, which are drawn from a variety of disciplines in the natural and social sciences, humanities and the arts. The institute is unique in its integrated approach to the study of intersections between science and technology, philosophy, social issues and leadership. The objective is to nurture a broad base of scholars, managers and leaders, who would respond to the complex challenges, facing by contemporary India and global society, with insight, sensitivity, confidence and dedication.
The institute has ample facilities for conferences, lectures and theatrical programmes. The JRD Tata Auditorium and the Lecture Halls facilitate an ideal atmosphere for long hours of deliberation and discussion. Situated on five acres of land within the verdant campus of the Indian Institute of Science, the buildings of NIAS have a strikingly distinctive architecture with elegant lines and arched corridors. The fully furnished guest rooms make the visitors’ and course participants’ stay a pleasant one. NIAS has an active programme of public lectures, regional, national and international conferences, symposia and seminars organised independently or jointly with other institutions, focusing on topical areas of research and public concern.

Dr. Raja Ramanna, as the Founder Director, immensely contributed to the growth and development of this Institute. Over a period of time, NIAS initiated several research programmes and other activities that brought recognition and fame. In subsequent years, Dr. Roddam Narasimha, Dr. K. Kasturirangan and Dr. V.S. Ramamurthy became the Directors of NIAS.

Mr. S. Ramadorai currently chairs the Council of Management and Prof. Baldev Raj is the Director of the Institute.

NIAS celebrates its Foundation Day on 20 June.
About the NIAS Consciousness Studies Programme

The NIAS Consciousness Studies Programme is an interdisciplinary programme of the National Institute of Advanced Studies. The programme brings in philosophy, cognitive sciences, animal studies, psychology, mathematics, physics and the neurosciences in its research mandate. The activities of NIAS Programme on Consciousness Studies began in the early nineties with Prof B V Sreekantan joining the Institute and subsequently, other members — Sangeetha Menon, Anindya Sinha, V V Binoy, Nithin Nagaraj, Sisir Roy, Gagan Deep Kaur and Venkat Rayudu — have become part of the team.

The Consciousness Studies Programme at NIAS, while adopting a larger framework, is disciplinarily grounded in humanities, neurophysics, behavioural and cognitive sciences, neurosciences, neuropsychology and neurophilosophy. We believe that there is a need to look at human experiences and consciousness as a whole and also in the interdisciplinary context of the humanities, biological, cognitive and the physical sciences. Appreciating the importance of this area of research and the efforts we have put, Prof. Mani Bhaumik — through the Mani Bhaumik Educational Foundation — has been continuously supporting us. The programme has also received funded projects and support grants from various institutions such as CSRI-DST, ICPR, Templeton Foundation and others.

Four international conferences, three national conferences and several landmark discussion meetings have been organised by the Programme and many experts within India and abroad have been attended; the proceedings have also been published. Some of our collaborators and speakers at the past conferences include Charles Townes, Jane Goodall, Roger Penrose, Stuart Hameroff and others. Our latest publication is the Edited Volume on “Interdisciplinary Perspectives on Consciousness and the Self” (Editors: Sangeetha Menon, Anindya Sinha and BV Sreekantan), and the Book “Brain, Self and Consciousness: Explaining the Conspiracy of Experience” by Sangeetha Menon; both the books were published by Springer.

The faculty members of the NIAS Consciousness Studies Programme include Sangeetha Menon, Anindya Sinha, V V Binoy, Nithin Nagaraj, Sisir Roy and BV Sreekantan. Apart from the core faculty members, the Programme also has several Adjunct Faculty and collaborators from institutions across the country and abroad. The doctoral scholars of the Programme include Lakshmi K (degree awarded in 2015), Namitha Kumar, Shankar Rajaraman and Siddharth S. Gagan Deep Kaur is a post-doctoral associate with the Programme. The Programme also has long-term and short-term NIAS Mani Bhaumik Research Fellows. Venkat Rayudu is a long-term NIAS Mani Bhaumik Research Fellow. The short-term Fellows during the period 2014–2015 include: Pravesh Parekh, Adwaith Deshpande, Rajgopal Dora, Stephen Salazar, Pankaj Taylor, Roshan K. S Sathyavrathan, Mukta Wate, Akshata Bhat, Abhinav Kadambi, Sathyya Narayana Sharma and Geetha Anand.

To know more about the Programme, please visit www.niasconsciousnesscentre.com
Consciousness, Cognition and Culture

Implications for the 21st Century

Sangeetha Menon

The NIAS Consciousness Studies Programme is organising the fourth international conference on “Consciousness, Cognition and Culture: Implications for the 21st Century”. Like all our previous conferences, our vision for this conference is also to bring out the latest and the most important discussions on consciousness on table. The spectrum of themes for the conference will cover abstract and theoretical concepts on one side, while physical, biological, cultural, psychological and philosophical perspectives on the other. The goal is to open a broader space to place intricate ideas that are complex by being multidisciplinary and transdisciplinary, yet shedding light on understanding consciousness. The conference sessions will be based on themes that are central to understanding consciousness in the context of cognition and culture.

While we still do not understand the nature of consciousness per se in species other than humans and higher mammals, serious attempts are now prevalent in the realm of science and allied disciplines to understand the nature of intelligence and basic cognitive capabilities across the animal world and plant species. The session on “Cognition and Consciousness across Species” will give a perspective about the evolutionary nature of mind and consciousness, while also raising questions such as “are life, cognition and consciousness are inter-related phenomena?”.

Who is an agent? Is consciousness always intentional? These questions bring significant discussion on considering consciousness in the realm of content and information and raising the minimal features for an intelligent system to have agency and authorship. Further, important issues in this context include the existence of free will, biological determinism and moral agency. Some of these questions will be raised in the session on “Agency, Information and Brain–Computer Interfaces”.

Consciousness and self are like the two sides of a coin. It is almost impossible to talk about consciousness without a self who is the experiencer, possessing self-identity accrued upon and influenced by one’s experiences, biases, memories and interactions with the environment. But then how do we understand the altered self, the self that is in the fringes due to neurological and neuropsychiatric challenges. How do we understand the self that seeks and gains transformation for wellbeing? How are mind, consciousness and the self-related? What are the different models of self? Do they have a biological basis? The session on “Models of Altered Self” will highlight these difficult but important questions.

There is general agreement that consciousness is a complex phenomenon that has to be looked upon as other than cognitive and rational capabilities, beyond the Baconian and Cartesian models of mind. One way of perceiving consciousness with its complexity is to consider consciousness as a unitary phenomenon which integrates deeper realms of mind, such as imagination and emotion, under its umbrella. What is the role of emotions in understanding consciousness? What is the neurological basis of meditative states? How do we understand concepts of beauty and the sublime, artistic and poetic expressions, and their relation to mind? What are the cognitive bases of decision-making? The session on “Social Cognition, Imagination and Meditation” will bring in some of these questions.

Though one might argue that consciousness is a unitary concept or an entity with cognitive and linguistic overload, it is impossible to place consciousness outside the larger living space of human culture. The repertoire of behaviour, attitudes and values that we behold has its origin in the cradle of culture — both biological and societal. The emergence of dispositions, such as empathy and altruism, or our abilities to cope with challenges and to move on — are these networked neurologically? Do we have capabilities to go beyond the physical underpinnings of our body and embrace deeper spaces of our “being”? What
are the implications of cultural neuroscience and medical humanities in the context of understanding the deeper realms of mind and consciousness? Can we ever move forward in understanding consciousness without giving a place for pure experience? The session on “Arguing for Pure Experience” will present a few interesting arguments and case studies on these points of view.

Many of the basic sciences began with questions on the fundamental nature of reality. What is the stuff the universe is made of, and would that core be connected to human mind and consciousness in intricate manners that we cannot imagine? How does the brain create a magnificent world that is presented to us as real? The discussion on ‘what is real’ bridges philosophical thinking, biology and physics in exciting manners by bringing in questions about life and its origin, and the connections between the microcosm and the macrocosm. The goal of the session on “Realism, Physics and Mathematics”, and the extended symposium on “Reality in Physics and Classical Traditions” hope to bring in a dialogue on these questions.
Acknowledgement to Supporters and Media Partner

The National Institute of Advanced Studies and NIAS Consciousness Studies Programme acknowledge the support received from the following institutions for organising the conference:

- Tata Education Trusts
- Cognitive Science Research Initiative (CSRI), Department of Science and Technology, Govt. of India
- Science and Engineering Research Board (SERB), Govt. of India
- Tata Consultancy Services
- Tata Steel
- Indo-US Science and Technology Forum (IUSSTF)

We record our heartfelt thanks to Prof Mani Bhaumik and The Mani Bhaumik Educational Foundation for their continued support to the NIAS Consciousness Studies Programme.

We also thank our Media Partner - Nature India

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LIST OF PARTICIPATING INSTITUTIONS
**Institutions from India**

1. Centre of Behavioural and Cognitive Sciences, University of Allahabad, Allahabad
2. Center for Neural and Cognitive Sciences, University of Hyderabad
3. Cognitive Neuroscience Centre, Department of Neuroimaging and Interventional Radiology, National Institute of Mental Health and Neurosciences, Bengaluru
4. COMMUNICATION DEALL (Early Intervention Programme for Children With Autism Spectrum Disorders), Bengaluru
5. Department of Education, Maonmaniam Sundaranar University, Abhishekpatti, Tirunelveli
6. Department of Philosophy, University of Delhi
7. Department of Psychology, Christ University, Bengaluru
8. Department of Neurophysiology, National Institute of Mental Health and Neurosciences, Bengaluru
9. Department of Psychiatry, National Institute of Mental Health and Neurosciences, Bengaluru
10. Department of Clinical Psychology, National Institute of Mental Health and Neurosciences, Bengaluru
11. Department of Sanskrit, Thakur Sen Negi Government College, Reckong Peo, Kinnaur
12. Department of Pedagogical Sciences, Faculty of Education, Dayalbagh Educational Institute, Agra
13. Department of Human Development and Family Studies, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat
14. Department of Bio Medical Engineering, Institute of Nuclear Medicine and Allied Sciences, DRDO, Delhi
15. Department of Management Studies, Indian Institute of Science, Bengaluru
16. Department of Management and Commerce, Sri Sathya Sai Institute of Higher Learning Brindavan Campus, Bengaluru
17. Gokhale Memorial Girls College, Kolkata
18. Indian Institute of Technology, Mumbai
19. Indian Institute of Technology, Jodhpur
20. Indian Institute of Technology, Kanpur
21. Indian Institute of Technology, Patna
22. IIIT- Rajiv Gandhi University of Knowledge Technologies, RK Valley campus, Andhra Pradesh
23. Indira Gandhi National Open University, Delhi
24. Kalinga Institute of Industrial Technology University, Bhubanewar
25. M S Ramaiah University of Applied Sciences, Bengaluru
26. National Institute of Technology (NIT), Calicut, Kerala
27. National Brain Research Centre, Manesar, Haryana
28. School of Cognitive science, JadHAVpur University, Kolkata
29. VIT University campus, Chennai
List of Participating Institutions

Institutions from Other Countries

1. Centre for Comparative Studies of Civilisations, Jagiellonian University, Krakow, Poland
2. Higher Institute of Information Technology and Information Systems, Kazan Federal University, Kazan, Russia
3. Carnatic Alchemy Project, New England Conservatory of Music, Cambridge, MA, USA
4. Doctoral School of Psychology, Eötvös Loránd University, Budapest, Hungary
5. Institute of Psychology, Department of Clinical Psychology and Addiction, Eötvös Loránd University, Budapest, Hungary
6. Institute of Cognitive Neuroscience and Psychology, Hungarian Academy of Sciences, Budapest, Hungary
7. Primate Research Institute, Kyoto University
8. The Visual Math Institute, Santa Cruz, CA
9. Centre National de la Recherche Scientifique, Paris, France
10. Computer Science & Engineering, University of Washington, Seattle, WA
11. Nicolelis Laboratory, Duke University Medical Center, Durham, NC
12. Department of Philosophy, Duke University, Durham, NC
13. Mind, Brain Imaging and Neuroethics Research Unit, University of Ottawa Institute of Mental Health Research, Royal Ottawa Mental Health Centre, Ottawa, Canada
14. Department of Oriental Philosophies, Institute of Philosophy, Russian Academy of Sciences, Moscow
15. Center for Medical Humanities, Compassionate Care, and Bioethics at Stony Brook University, NY
16. Keck Center for Neurophysics, UCLA (University of California, LA), USA
17. Radboud University, Nijmegen, The Netherlands
18. Faculty of Philosophy, University of Groningen, The Netherlands
ABSTRACTS OF INVITED LECTURES
Evolutionary Origins of Human Mind Viewed from the Study of Chimpanzees

This talk compares cognition and behaviour in humans with those of chimpanzees. I have studied chimpanzees during fieldwork in Africa and in laboratory at the Primate Research Institute (PRI) of Kyoto University in Japan. The laboratory study, started on April 15, 1978, is known as the Ai project. The research partner is a female chimpanzee named “Ai”. The laboratory study has been focusing on the computer-controlled cognitive skills of chimpanzees at the PRI community of 13 individuals of three generations (ongoing studies are already published online at http://langint.pri.kyoto-u.ac.jp/ai/). The field study has been focusing on the tool use and cultural behaviour of wild chimpanzees at Bossou-Nimba in Guinea, West Africa. The chimpanzees in Guinea have the unique cultural tradition of lithic technology using the stone tools as hammer and anvil to crack open oil-palm nuts (ongoing field studies are published at http://www.greencorridor.info/). Taken together, the talk focuses on the socio-cognitive development of humans and chimpanzees. Humans and chimpanzees are largely similar at early developmental stages, but there are several crucial differences. Chimpanzees have been very rarely observed to engage in general imitation and active teaching. Young chimpanzees possess exceptional working memory, often superior to those of human adults. In contrast, their ability to learn the meaning of symbols is relatively poor. Chimpanzees show collaboration and altruistic behaviour to some extent, but not as much as humans do. The human infant is characterised by the stable supine posture of the neonate that enables face-to-face communication via facial expression, vocal exchanges, manual gestures and object manipulation, because both hands are free. The stable supine posture helps to make us human. Human infants are typically raised by more than one adult; apart from mother, father, siblings, grandparents and other members of the community also involve in raising infants.

The development of social cognition in humans may be integrally linked to this mother-infant relationship as well as to the species-specific way of rearing children. Based on the parallel efforts including fieldwork and laboratory study of chimpanzees, this talk presents possible evolutionary and ontogenetic explanations on the aspects of cognition and behaviour that are uniquely human.
Sniffing the World: The Influence of the Olfactory System on the Evolution of Cerebral Cortex and the Structure of Human Cognition

Most current theories of human cognitive function, including speculations regarding human consciousness, have been considerably influenced by studies of the visual system — perhaps not surprising given the assumed dominance of the visual system in primates including humans. The hypothesis to be explored in this talk, however, is that it is olfaction, not vision or the other primary senses, which is fundamentally responsible for “inventing” the algorithm manifest in cerebral cortical circuitry on which cerebral cortex and accordingly human cognition is based. The argument will be made that unlike vision, where a great deal can be inferred from ‘local’ computational algorithms; even the basic olfactory object recognition requires a context dependent associative process. Hence, we have proposed that the emergence of neocortical sensory areas for vision, audition, somatosensation and gustation involve secondary elaboration of a basic cortical computational architecture that first evolved in the context of olfaction. The talk will briefly discuss the experimental evidences for this hypothesis from the fossil record, which suggests that the brains of early mammals resembled those of small highly olfactory mammals whose brains are also dominated by olfactory structures. In addition, evidences from the phylogenetic analysis of the reptilian dorsal cortex will be presented, suggesting an early intimate relationship between olfaction and the dorsal expansion of the forebrain. This phylogenetic analysis will be used to describe a proposed evolutionary sequence, resulting in the eventual development of neo-cortex.

However, the major focus of the talk will be on the physiological and functional implications for a dominant role of the olfactory system in cerebral cortical evolution. This includes implications related to cortical dynamics and their influence on function, as well as the re-interpretation of essential features of human cognitive behaviour, viewed from the point of view of olfactory computation. Combining our model-based analysis of olfactory cortical dynamics with our experimental studies on the influence of respiratory patterns on cortical behaviour, the talk will conclude with a novel explanation for the physiological origins and characteristics of human meditation.
Animal cognition comprises of processes used to generate adaptive or flexible behaviour in various species of animals. It involves understanding and comparing different varieties of cognitive mechanisms including learning, memory, perception and decision-making between humans and other species. Some of the arguments for the presence of animal mind include problem-solving, communication, theory of mind, tool use, brain structure and function, behaviour and perception. Additionally, a number of studies have focused on emotions, judgement, empathy and social interactions in mammals, especially in primates. Humans undoubtedly excel and outperform all other species in different aspects of cognition, followed by great apes and monkeys. Recent studies have, however, demonstrated that a number of higher cognitive functions are performed with equal ease by different species of birds.

Amongst birds, those belonging to the family Corvidae (including crows, rooks, ravens, jays and starlings) are known for their problem-solving abilities from ancient times. Examples include raising the level of water in a container using stones (immortalised by the Panchatantra and Aesop’s fables) and the ability of New Caledonian crows to manufacture tools to extract food (insect larvae) from their habitat — both of which have been tested and verified in laboratory settings. Food-caching birds (western scrub-jays) provide examples of corvids possessing a ‘Theory of Mind’ — scrub-jays, which pilfer from food stores of other birds, are known to take more precautions while caching their own food. Besides their problem-solving abilities, corvids are excellent at visual perception and can recognise complex patterns, shapes, colours and even human faces. Whereas corvids are known for their abilities of problem-solving, passerine songbirds are amongst the few species, besides humans, bats and cetaceans, who learn species-specific vocalizations (birdsong) from a tutor during a sensitive period early in development.

Another interesting aspect of cognition is self-awareness, which has been assessed by the ‘mirror-recognition’ test; this has been observed in some species of birds such as magpies, besides the great apes. However, just as not all species of monkeys can recognise themselves, self-awareness does not seem to be present in all species of birds. In my talk, I shall present some examples of avian cognition, such as problem-solving and tool-use, in addition to the experimental results obtained from my lab on self-awareness in zebra finches (songbirds) and house crows. I shall also present the experimental results on the visual abilities of house crows to recognise complex patterns. Further, I shall present data on the structure of the corvid brain and the song control system in songbirds for demonstrating the similarities between the avian brain and that of primates including humans; this will provide links between the avian brain and behaviour.

Birds and primates occupy similar ecological niches, face similar challenges in foraging for food and live in large social groups. Despite the fact that brain evolution is divergent in birds and mammals, evolution of brain function is convergent. It is, therefore, important to study the evolution of intelligence and consciousness in both orders of vertebrates.
Animal Consciousness: Some ‘Fishy’ Facts

Consciousness in animals and its evolutionary continuity have been the topics of controversy in both science and philosophy. There is a plethora of literature available supporting as well challenging the argument that, animals are also ‘conscious’ and like every trait consciousness also has an evolutionary history. However, studies exploring consciousness in animals are handicapped by the unavailability of an unquestionable definition for consciousness and the absence of a gold standard protocol for proving this phenomenon in non-linguistic species.

Fish, the animal located in the base of the tetrapod evolution, has attracted the attention of the consciousness researchers with its cognitive abilities, complex social life, and the brain with functional and molecular properties analogues to the brain of the evolutionarily advanced vertebrates. Interestingly, some authors believe that “fishes are unlikely to feel pain” and hence, these animals cannot possess the “phenomenal consciousness—the subjective experience of sensory stimulus”. Meanwhile, others sympathise that fish has been a “victim of speciesism”, and it is not easy for human beings to accept them as a ‘conscious organism’. Furthermore, many ichthyologists strongly believe that evidences are compelling, and ‘Cambridge Declaration on Consciousness’ should have included fishes also in their list of ‘organisms having sentience and consciousness’.

This paper will elaborate the concept of consciousness in animals in the light of the recent research and debates on cognition and consciousness in fish.
What is reality and how does the brain create perception of reality? While this question has been debated by philosophers for centuries, concrete scientific investigation has remained elusive. Technological advances in several fields — especially, high speed computing, virtual reality and brain-machine interface — have recently made it possible to address these fundamental questions scientifically. Using these techniques, we have investigated one aspect of these big questions: How does the brain create perception of abstract space and time? All animals must move in space as a function of time and hence, must have a very clear perception of space-time, one that all other animals across different species must agree upon. Yet space and time are abstract as they cannot be directly touched, seen, or smelled. How is this abstract sense of space created on the fly?

To address this, we measured the activities of large number of neurons, while subjects explored either real or virtual space and developed biophysical computational models that can capture the experimental findings. The results are quite surprising. Although the subjects behaved similarly in the real and virtual worlds, the neural responses were dramatically different. In fact, even the brain rhythms, crucial for learning and perception, were significantly different in the real and virtual worlds.

The results elucidate how neuronal networks differentiate real from virtual space and the perception of abstract space. Additionally, they have important implications for diagnosing and treating learning and memory related disorders.
One of the most profound mysteries in science today is how the activities of a hundred billion neurons in the human brain give rise to what we call cognition and behaviour. In this talk, I shall first review some of our work on Bayesian models of cognition, starting with the deep predictive coding model of cortical function and culminating in a Bayesian model of decision making. Predictions of the models will be compared with neurobiological data.

I shall then describe a complementary approach for not only understanding but also restoring and augmenting brain function through brain-computer interfaces and brain-to-brain interfaces.

Additionally, I shall provide examples of such interfaces developed both from my laboratory as well as from the centre that I direct, the NSF Centre for Sensorimotor Neural Engineering.
Flow of information is as important and essential as flow of energy in living organisms for their functioning. Information flow is carried by neural signals — stochastic sequences of action potentials produced by interconnected network of neurons in response to external stimuli. Understanding information flow between individual as well as a network of neurons in a complex system, such as the brain and the central nervous system, has been an ongoing area of active research in computational neuroscience.

In this talk, we shall begin with a brief primer on the basics of information theory — understanding concepts, such as Shannon entropy, mutual information and channel capacity, and their application in neuroscience. We shall attempt to understand how neuronal networks achieve their remarkable information processing abilities. The brain is known to heavily compress the noisy but redundant data it receives from the sensory systems of the organism. According to Shannon’s noiseless coding theorem, the entropy of a signal determines precisely how much (lossless) compression is theoretically possible and thus, sets a fundamental limit that must be respected by any system, including the brain and the central nervous system. Hence, robust and efficient estimation of Shannon entropy of noisy neural signals based on simulated as well as experimental data continues to be an active area of research in neuroscience. After a brief review of various methods to estimate entropy of neural signals, we shall explore current trends in using complexity measures such as Lempel-Ziv complexity, algorithmic complexity, grammar complexity and effort-to-compress as a proxy to entropy.

Challenges and open problems in utilizing information theory in neuroscience will be discussed, highlighting the directions for exciting future research work.
Hierarchical Event Control and Agency

Event control approach considers predictability and control of the effect of actions as the basis of human behaviour and perception. According to event control approach, the experience of self emerges out of control over perceptual-action events. We interact with our environment by controlling events that occur simultaneously at different spatio-temporal scales organised in a hierarchy. In the hierarchy, more distal event-control is higher in the hierarchy compared to the more proximal event control. The sense of self emerges out of interaction between different levels of this control hierarchy with sense of self being attached to the highest level at which control is exercised. This talk will discuss empirical findings on control at different hierarchical levels and the manner in which control at different levels influences sense of agency and event perception.

Control of perception at different hierarchical levels (global and local) was studied using hierarchical stimuli (a large letter made up of small letters) and by varying the noise present in the environment. The time taken by participants to exercise control on each trial was measured along with explicit confidence rating of control for an entire block. The Hurst exponent for global level control was higher compared to that for local level, suggesting that control of information at these two levels operates on different time-scales. Control ratings also varied as a function of noise for the local level but not for the global level.

The relationship between sense of agency and event control hierarchy was studied using a novel multi-agent (sheep-wolf) paradigm. Participants controlled an agent (a wolf) with the help of a joystick to catch a computer-controlled agent present on the screen (a sheep) that is present along with other physically identical computer controlled agents. The amount of perceptual motor control afforded by the joystick was manipulated, and the information related to goal completion, correct identification and confidence rating of identification, and authorship were measured. Sense of agency increased with increase in control at lower perceptual-motor level only when the higher-level goal was not achieved. When the higher goal level control was exercised, confidence ratings for sense of agency became independent of the control at lower level. The results provide strong evidence that control hierarchy influences sense of agency.

We also investigated the influence of control hierarchy using an implicit measure of SoA (intentional binding). Participants aimed at a target by moving a joystick and hit the target using the joystick trigger. The joystick control was noisy. At the end of the control task, participants made a trigger press and estimated the interval between their action (trigger press) and the perceptual event (circular disc). Results show that the estimated interval is sensitive to sensory-motor predictability but only when top down goal is not completed providing support for event control approach. We also manipulated feedback regarding goal completion and showed that this influences the way events are perceived subsequently influencing perceived time. Overall the results from all these experiments support and demonstrate the importance of hierarchical event-control.
Despite the enormity of recent claims that a human brain will soon be simulated on a digital computer, very little scientific scrutiny has been given to examine the very basic tenant of this proposal: Can a digital machine simulate the higher functions of a human brain?

In this talk, I shall discuss mathematical, computational, evolutionary and neurophysiological arguments to deny the feasibility of such a claim. I will show that modelling organisms, such as animal brains, in digital computers is hindered by non-computable and non-tractable problems that not even modern supercomputers can effectively handle. On the contrary, using the relativistic view of the brain, I propose that a complex central nervous system generates, combines and stores information about itself, the body and the external world through the recurrent dynamic interplay of a hybrid digital-analogue computational engine. At this engine's core, the electrical firing produced by widely distributed networks of neurons flows through a large variety of “biological coils”, formed by the nerve bundles of the brain’s white matter core, continuously generating variable and complex electromagnetic fields (NEMFs). According to my theory, the manifold, created by the continuous interferences of these NEMFs, works as a “biological analogue computer” — the neuronal space-time continuum, from which a “mental space” emerges to underlie most of the brain’s higher-order functions. Interactions between this “mental space” and incoming peripheral sensory signals are stored in a distributed way in the brain. Since neither the generation of the NEMFs nor their interplay with billions of neurons is either tractable or computable, any attempt to effectively simulate the true complexity of the brain in a digital computer or any other Turing machine has no credible chance to succeed.
What Brain Imaging can Tell Us about Self and Consciousness?

Recent neuroscience ventures are involved in deep research of the neuronal mechanisms underlying mental features like self and consciousness. However, both neuronal mechanisms and the exact definitions of original philosophical concepts, like self and consciousness, remain unclear until today. My talk will focus on the recent studies by our group on the neuronal mechanisms underlying our sense of self as well as consciousness. Specifically, I shall present recent data on the close and rather intricate relationship between self and resting state, the so-called self-rest overlap. These data and the abnormalities of self in psychiatric disorders, like depression, suggest that the concept of self may signify a basic and foundational function of the brain's spontaneous activity rather than higher-order cognitive functions related to stimulus-induced activity. This will be complemented by a second part, where I shall focus on consciousness and present data from altered states of consciousness as in vegetative state (VS) and anaesthesia. These data show involvement of altered spatial, especially, temporal structure in the spontaneous activity of these patients as well as major decrease in GABA-A receptor density. This again suggests that consciousness may be a basic function of the spontaneous activity and its excitation-inhibition balance. I conclude that both self and consciousness are the most basic functions of our brain's spontaneous activity and its spatiotemporal structure. This not only entails change in our definitions of self and consciousness but going beyond it also carries major implications for philosophical questions regarding mental features and the mind-brain problem; these shall be discussed at the very end of my talk.
Schizophrenia is a disorder of brain functioning, affecting one of every 200-300 individuals, with the onset typically during adolescence or early adulthood. There are many classical symptoms of schizophrenia; the most well-known and perhaps the most studied of these symptoms is the experience of auditory hallucinations.

Hallucinations are perceptual experiences that occur in the absence of real stimuli that evidently cause those perceptions. The most common type of hallucinations that are experienced by patients with schizophrenia is the auditory hallucinations. These ‘voices’ are experienced by the patient as real, thereby indicating that such experiences occur in the context of an aberrant self-experience or self-awareness.

Functional integration, involving synchronous activity of multiple brain regions or networks, is shown to underlie various brain states, experiences, or cognitive functions. Therefore, examination of functional connectivity of the brain regions during the experience of auditory hallucination in comparison to perceptual experiences of real stimuli could throw light into the brain networks underlying normal self-awareness versus the networks that underlie aberrant self-awareness during the experience of hallucinations.

Thus, auditory hallucinations in patients with schizophrenia provide us with a unique window of opportunity to examine the brain networks that underlie not only aberrant but also normal self-awareness. Results of a functional magnetic resonance imaging (fMRI) study using a novel paradigm, in subjects with schizophrenia experiencing continuous auditory hallucinations during scanning, will be presented. The implication of differential functional connectivity between various brain regions during normal perception and during the experience of auditory hallucinations, towards understanding self and its aberrations, will be discussed.
Neurosciences and neuroscientists are increasingly occupying the centre stage in debates on issues that form the central themes of this conference. Some of the most intriguing insights in this area (of mind, brain and consciousness) have emerged from the neurological literature and their popular versions; Oliver Sacks, V. S. Ramachandran and Anil Ananthaswamy in their writings exemplified adult patients, who suffer from relatively common disorders, such as strokes, head injuries and dementias, as well as the rarer neurological disorders such as encephalitis lethargica or Cotard’s syndrome. The literature mostly focus on adults, who have had a relatively long period of normal life experiences, but who experience altered forms of consciousness and self due to some neurological illness, leading to myriad complex issues in the daily life of the individuals, including their notion of self and consciousness. The experiences and difficulties of these individuals raise a whole range of questions on the role of the brain in our notion of self, including the body and mind of the self vis-à-vis the external world and the others in it. Little is known as yet about similar issues that might possibly be present in some children and could underlie complex developmental disorders such as the autism spectrum disorders (ASD). Some recent narratives from young individuals diagnosed with ASD would suggest that their bodily experiences are at variance with that of most of us, presumably resulting in varied ‘consciousness’, culminating in notions of self that are not unexpectedly quite different from the average or the ‘norm’, and the expectations that arise there from and that we hold them to, all through their developmental years. Support for this viewpoint will be drawn and illustrated from self-narrations and clinical experiences drawn from individuals with ASD.

Unlike the adult neurological patients whose ‘normal’ or ‘typical’ selves are altered consequent to neurological insult, the instances in ASD patients are not of ‘altered selves’ but of ‘selves’ that are ‘alternate selves’, born and grow in environments and experiences that are unknown and alien to us. The immediate question arises: What are their notions of self and consciousness and our expectations of them, in terms of our notions of self and consciousness?
Social interactions are fundamental for human development and survival. Successful adaptation to changing social world requires one to constantly think and scrutinize one’s own thinking as well as other’s thinking. This unique ability of ‘thinking about thinking,’ called metacognition seems so intuitive that the importance is underscored only by the loss of these functions in disorders like schizophrenia.

The clinical presentation of schizophrenia, a common neuropsychiatric disorder, provides typical examples of distortions in two key components of meta-cognition, self-reflection and social cognition. The neurobiological basis of this enigma posed by co-occurrence of these two seemingly discrete cognitive functions is sparsely examined; despite advances in understanding the psychotic symptoms of schizophrenia, neurobiological basis of metacognitive dysfunction in schizophrenia is poorly understood. The role of dopamine in psychotic symptoms of schizophrenia is well established. However, it has been increasingly recognised that dopamine may only be a final common pathway, while other molecular mechanisms may contribute to other symptoms of schizophrenia. Studies using functional magnetic resonance imaging (fMRI) in healthy volunteers have reported involvement of cortical midline structures in self-reflection and social brain regions in social cognition. Schizophrenia patients, who have abnormalities in self-reflection and social cognition, also exhibit aberrant activation in both cortical midline structures and social brain regions.

This talk would focus on understanding the neurobiological basis of metacognitive dysfunction in schizophrenia using neuroimaging methods and discuss whether the subcomponents have a shared or overlapping neural correlates. By applying principles from simulation theory, this talk will attempt to link the two disparate components of metacognitive functions.
Some say that consciousness of how the self seems can teach us how the self is. But the nature of the self is subject to deep cultural variation. In this talk, I shall discuss a dozen differences in the way self seems between North American populations and East and South Asian populations, and what such variation can teach us about the nature and plasticity of the conscious self.

The differences include variations of self-consciousness in terms of whether one conceives of the self as a stable, permanent essence, or an impermanent unfolding process; whether the self is conceived in terms of stable character traits, social roles, or situation; whether the self is conceived as transparent or opaque to its owner; whether the self is conceived atomistically or relationally.

Such differences show up in both descriptions of how a self is and in norms of what selves ought to be like. The dozen variations in self-consciousness help to focus on what is given and what is variable about how selves seen, which in the case of selves may be the way selves are.
The deeply forgetful people are in the grip of a dementia syndrome resultant from any number of diseases, including but by no means limited to Alzheimer disease. The metaphysical perspective on their consciousness is important to how we describe their being. Are the deeply forgetful — to draw on common metaphors heard in clinical settings and from some family members — gone, already dead, empty, absent, husks, shells, etc.? Such a perspective assumes a materialist perspective on the nature of consciousness in which it is entirely derived from matter, brain tissue, cells, chemistry and so forth.

I shall refer this first perspective as brain physicalism and explore its implications for how we think about the deeply forgetful, and how much moral consideration we afford them. Alternatively, what happens if we view the deeply forgetful as having some degree of mind and consciousness that is in fact a small drop of the ocean of supreme consciousness, as Hinduism asserts and as the Abrahamic faiths capture in their idea of an eternal soul “in the image of God”?

I shall refer this second perspective as substance dualism, drawing a clear metaphysical divide between the material neurological substrate and some aspect of consciousness that interacts with it but has its own underived primacy in supreme consciousness.

How do we think differently about memory itself, the significance of continuing hints of self-identity, dignity and moral inclusivity in a shared humanity under the conditions of deep forgetfulness will decide which of those two perspectives we take.

Why do some highly regarded philosophers, theologians and neuroscientists still reject brain physicalism, and how do their arguments pertain to the deeply forgetful as well as how we treat them? Does the actual experience of the deeply forgetful, considered in the light of phenomenology, provide more or less evidence for substance dualism than for brain physicalism?
The Problem of Qualia in the Perspective of the Buddhist Theory of Consciousness

The term qualia refers to the properties of sensory experience, which being subjective, unique and non-transmissible by their very nature, constitute modes of experiencing the world characteristic of each human being but accessible only from the first person perspective. In the most promising contemporary scientific theories of consciousness, the notion of qualia is viewed as an insurmountable obstacle to their final triumph. Qualia remain the last bastion of subjectivity, which cannot be taken by assault with the help of purely "objective" scientific methods.

In the Buddhist theory of consciousness (citta, vijnāna), the problem of subjectivity has taken a specific turn of subjectivity without referring to any permanent subject or "Self" (Ātman). Some Buddhist scholars call it the minimal sense of “I” or “Self”, which is reduced to the sensation that this or that experience is “mine” and does not belong to any other person (other streams of dharma — elements of experience).

In this talk, I shall dwell on the Buddhist way of understanding the subjectivity of experience and on their notion of self-awareness (svasamvedana, svasmvitti) which makes my experience "mine". Additionally, I shall try to trace the development of this problem from Abhidharma authors to Dignāga and Dharmakirti.
The most central presupposition of science, perhaps, is that objectivity is universal. This does not only create a blindspot in knowledge, but also forces one to ignore it. Several strategies were accordingly adopted in the West to overcome this ignorance.

One of them is Phenomenology, with its project of stripping the layers of interpretation by way of a complete suspension of judgment (epoché) and evaluating any claim of knowledge from such a basis of “pure consciousness”.

Another one is pan-experientialist metaphysics that puts back pure experience in the very domain that was deprived of it by the act of objectification.

I shall compare these approaches of pure experience, thereby establishing a hierarchy of radicality between avoiding the blindspot from the outset and compensating for it retrospectively.
Consciousness, Cognition and Culture

Emotions and Imagination Working Behind Expression

In this proposed talk I shall focus on the role played by metre, idiom, diction and figures of speech that enrich the total aesthetic appeal in classical Indian poetry; such aesthetic appeal is nothing but emotions sublimated and imagination brought into action.

Any truly accomplished poet’s intensely contemplated rich emotions are bound to find their way in one or the other form of beautiful expression. This power of contemplating the deep emotional experiences with a dispassionately compassionate sense may be termed as imagination or pratibhaa, according to Indian aesthetics.

This unique capacity of a true poet naturally finds its expression in the form of a beautiful poem which can either be in prose or verse/song or even in a mixed form as Indian poetics — never restricted any linguistic form unlike its Western counterpart. However, it has rightly preferred a chiselled form that is beautiful in terms of both sound and sense. Metre and various types of alliterations take care of the aspect of aesthetic sound in a poem, while idioms, grammar and figures of speech look after that of sense. Diction, imagery and style extend in either side. But the success rate of all these elements depends upon their intrinsic power of lingering suggestion that is endorsed by a deeper sense of propriety. Indian aesthetics boils down all these parameters into a few major concepts such as vakrataa (all the beauty of poetic expression that is created in terms of sound and sense), aukhitya (propriety that has a contextual final say on the acceptance or rejection of suggestion that has sprung from the poem under consideration), dhvani (suggestion that triggers aesthetic enjoyment) and rasa (the aesthetic experience).

In the light of these basic concepts, the already mentioned parameters, such as the metre, diction, idiom, imagery or figures of speech etc., will be enumerated in detail with reference to some of the selected verses mainly culled out from the vast lore of classical Sanskrit and a few from similar Prakrit, Kannada, Telugu and other literatures so that the intriguing aspects of imagination and emotions are unveiled to the possible extent. Issues like the relationship between prosody and emotions, nature and structure of imagery v/s emotions, and diction vis-à-vis emotions will be discussed along with their implications in the poetic imagination.

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Brain, Cognitive Reserve and Neural Basis of Consciousness

The brain is endowed with the phenomenon of plasticity and hence, has the ability to reorganise the brain circuitry throughout life as a function of experience. Additionally, brain is endowed with countless degrees of cognitive reserve capacities that can bring about changes in network properties. Modern scientific studies have provided ample evidences of enhanced structural plasticity, fibre tract integrity, enhanced brain synchrony and oscillations — the electrophysiological correlates of enhanced attention, cognitive functions and sensory motor integration, associated with meditative practices.

The associated mental attributes include greater psychological development and personal growth and well-being leading to altruism, environmental mastery, etc. Proficient meditative practices are thus capable of providing various higher mental capabilities by transforming the brain network functions.

Such practices make the brain more flexible with anatomical variability to efficiently utilize the existing neuronal networks/recruit alternative networks to maximize the performance and mental capabilities. We are yet to understand the nuances of the brain and mind relations to understand the inner world of consciousness.

Our studies on neurobiology of schizophrenia and on understanding the neural correlates of Vipassana as well as on Rajayoga meditation provide us with valuable information on the cognitive reserve capacity as well as the phenomenon of the brain plasticity. We try to understand the neural basis of consciousness, with the empirical evidences from our studies.
Creativity is the mysterious quintessence of modern human society. Despite creativity being an integral part of human progress, it continues to reside in a mystery box shielded by locks of complexity and diversity. Creativity, be it scientific (in the form of discovery of electricity, medicines, utilization of natural resources to meet human needs) or artistic (in the form of ragas that could light up lamps or bring prosperous rains, poems that could brighten moods and paintings that could bring life to lifeless souls), is the essence of human life. However, creative process remains a mystery as most creative individuals are unable to explain how they come up with those unique, novel and original ideas. Fortunately, with the advancement of technology, it has been possible to peep inside human brains and map the brain functioning while they are involved in a task. However, one must remember that creative ability like all other abilities is not just a mere firing of neurons in the brain but is rather an end result of abstract, subjective human experience and their unique cognitive styles translated into a tangible, concrete product. Perhaps, creativity can be best understood as a vehicle of self-expression, which is an amalgamation of objective and subjective experiences. This has been the guiding principle of the research being carried out at NIMHANS that assesses the brain correlates of creativity.

The aim of the study was to explore the brain correlates of creativity. Sample comprised of two groups — creative group (CR) and matched normal controls (NR) with N = 30 each. All participants were in the age range of 20–40 years and had minimum average intelligence (IQ > 90). The groups were matched on age, gender (23 males and 7 females in each) and years of education. The creative group included a heterogeneous mix of established creative artists (designers, musicians, dancers, writers and theatre artists), whose work had been recognised in their field. Control group comprised of normal, healthy adults from the community with no demonstrated artistic creativity. Written informed consents were obtained from all the participants, and the study was approved by NIMHANS ethics committee. These groups were assessed on cognitive abilities (NIMHANS Neuropsychology battery) and creativity (Wallach & Kogan Test of creativity). Wallach and Kogan creativity test was also administered inside the fMRI scanner and their brain activity was mapped as they thought creative ideas and novel responses.

Professionally, creative artists were found to score higher than normal group on all neuropsychological variables. Significant differences were found in focussed attention, category fluency, design fluency (free and fixed), visuospatial working memory, set shifting ability, response inhibition and verbal memory. Above stated results lend support to the idea that creativity is indeed a complex cognitive ability constituted by specific neuropsychological functions. Creative individuals were found to have higher cognitive abilities, and it was found to be mediated in the brain by various regions — bilateral frontal, temporal, precuneus and cerebellum. These results are poignant in ascertaining the brain correlates of creativity.
Large-scale human societies expect that criminal behaviour will be punished to ensure prosocial behaviour and long-term cooperation. The concept of third-party punishment entails usually state-empowered enforcers (e.g., judges, jurors), who will evaluate the perpetrator’s legal responsibility and determine the appropriate punishment that fits the crime. In virtually all models of the criminal law, the amount of third-party punishment is driven by two main considerations: the wrongdoer’s intention and the harm to the victim.

Recent neuroimaging evidence has revealed that third-party punishment is mediated by a replicable neural network; however, the underlying psychological and neural components as well as the context- and person-dependence of this network are still controversial. A rationale for a neural framework of third-party punishment is proposed with foundations in evolutionary theory. The unique human capacity for third-party punishment is not a result of a specialised cognitive module that specifically evolved for this social function. Rather it builds on existing fundamental cognitive mechanisms and its domain-general neural networks that emerged from more primitive forms of punishment, including second-party punishment (i.e. punishing wrongdoers with retaliation and revenge) to reduce the temptation to break social norms and first-party punishment (i.e. punishing ourselves with consciences and guilt) to reduce the temptation to violate norms in the first instance.

A body of evidence, combining paradigms from social psychology and behavioural economics with functional neuroimaging, transcranial magnetic stimulation, lesion and neuroendocrinal methods, will be provided; this begins to paint a cohesive framework for the neural underpinnings of third-party punishment. In particular, third-party punishment recruits an intuitive system for rapid evaluation of norm violations (e.g., anterior insula) based on the wrongdoer's intention and the inflicted harm to the victim (e.g., temporo-parietal junction, medial prefrontal cortex). In addition, a deliberate system is engaged for the representation of the response space to construct a scale of punishment (e.g., intra-parietal sulcus) and for the selection of the fitting magnitude of punishment (e.g., dorsolateral prefrontal cortex) to regulate the intuitive system in favour of more flexible decision making.

Knowing more about how our brains punish aims to stimulate the scientific debate about its neuroscientific implications not only in the field of criminal law but also in related fields such as moral philosophy, social psychology and evolutionary biology. Importantly, emerging evidence arms the criminal law with insights into how to better design processes for judges and potential jurors to make their punishing decisions and begins to form the outline of a new punishment paradigm that may enlighten, or at the very least enliven, age old debates about the purposes and limitations of punishment.
Is there a world of mathematics above and beyond ordinary reality, as Plato proposed? Or is mathematics a cultural construct? These questions have bedevilled the philosophy, history and psychology of mathematics since ancient times. Mathematicians themselves have contributed impressions of the reality of mathematical knowledge from their own experience on the creative frontier. Scholars from related disciplines — such as physics, phenomenology, creativity, neuroscience, etc. — have contributed their opinions.

In this brief article, we speculate on the place of mathematical reality from the perspective of the mystical cosmologies of the ancient spiritual traditions of meditation, psychedelics and divination. My dominant perspective here is that of my personal experience of mathematical research and of these ancient traditions, over some 60 years.

Here I propose that mathematical thinking is a form of meditation, and also, that traditional meditation practice facilitates mathematical thinking. Further, I am a proponent of the psychedelic hypothesis, according to which the ingestion of psychoactive substances has contributed to the evolution of human culture for 70,000 years or more. Finally, I argue that shamanic rituals and divination rituals in particular, have stimulated our cultural evolution for 30,000 years or so. All these propositions overlap and suggest a complex ongoing interaction between mathematical creativity and mysticism.

In other words, I side with the Platonists in thinking of mathematical reality as a world to be discovered. And I end with a speculation on cosmology as a complex dynamical system, bringing the great chain of being into the paradigm of chaos theory.
It is claimed, e.g., by the Buddhist written and oral traditions of the path of purification/freedom, that the systematic practice of concentration towards insight leads to deconditioning. Indeed, the practice of concentration brings serenity, thus making easier to face life. Moreover, continuous practice increases the resolution of attention; one can observe that the stream of consciousness is discrete and deterministic. Apart from being unpleasant, in fact unbearable (dukkha), this does not bring what was promised, therefore, it is paradoxical.

As discreteness and determinism are unavoidable, also well-known in neuroscience, therefore, one can consider that the reaction of dukkha is caused by the wrong view that we are in the middle of the universe and in control of what happens to us. However, this wrong view can be avoided and domesticated by systematic practice of attaining relaxed, concentrated and continuous mindfulness. The above mentioned paradox is thus solved. The wrong view makes us spend emotional energy in pretending that we are in control, thus causing to seriously limit the space of possible choices. This provides possible explanations for stubborn clinical mental phenomena.

We present a computational model for consciousness, the human hybrid universal Turing machine, in which these mental developments are possible. The model is the consequences of the foundations of mathematics, implying the Church-Turing Thesis on computability.
Matter and Consciousness in Indian Philosophical Analyses

Indians have inherited a highly reflective culture. The philosophers of the Vedic period, particularly, of the Upanishadic period, inquired into the entire existence — gross and minute, inner and outer, manifest and unmanifest, physical and spiritual.

There was absolute freedom of thought; as a result, multiple systems of philosophy came into existence, each promoting a distinct world-view. In all nine philosophical systems emerged, such as Samkhya, Yoga, Nyaya, Vaisesika, Purvamimamsa, Uttaramimamsa or Vedanta for one group called astika-darsanas and another group of three namely; Jainism, Buddhism and Cārvākā, called nastika-darsana.

The Cārvākās or the materialists reduced consciousness to matter. The Buddhists, although, believed in consciousness as a distinct category, they maintained that it is momentary. Among the astika darsanas, the realists called the Naiyayaikas equated it with cognition or knowledge and maintained that consciousness is the property of the conscious. The conscious is the knower. The Samkhya, Yoga, the Purvamimamsa and the Vedanta systems held that the knower is by nature conscious (cetanā). Taking all the philosophical positions together, we can see that these philosophers try to understand consciousness through four different models:

1. The Samkhya Model
   Here, the knower or the atman is treated as cetanā by very nature.

2. The Nyaya Model
   The Naiyayikas try to understand consciousness or caitanya which is quality of the self. Self is the holder or locus of consciousness. Thus, for them caitanya is a quality of the self.

3. Among the Vedantins, the Sankarites equate self with the consciousness itself. For them, there is no real difference between the cetanā and caitanya.

4. The Cārvākas hold that consciousness emerges from matter and returns to matter.

In this lecture, I would like to show the treatment of Jada and Cetanā in Indian philosophical discourses. In my opinion, each Indian Philosophical system is a model of understanding consciousness. The arguments advanced by Indian Realists, Idealists and Materialists may throw some light in better understanding of the nature of consciousness.
ABSTRACTS OF POSTER PRESENTATIONS
My paper begins with challenging three orthodox notions of the self, prevalent both in traditional as well as contemporary literature and discourse. The first is regarding its ontological category or status. The self has been viewed either as substance as Descartes did, or property as Spinoza thought, or as (‘internal’) process as Damasio and Galen Strawson proposed. All these hypothetical claims are not only difficult to establish and validate, but are also incoherent and incomplete account of the self. I argue that the self can never be established as subject to empirical perception, thereby objectification, which seems the basis for establishing an ontological category of any unit of reality. Secondly, in the traditional and current literature as well as popular understanding, the common idea or ‘myth’ is that self-consciousness is a conscious act, whereas I present it as an unconscious one. I argue that my consciousness accompanying my thoughts is an unconscious phenomenon. By the word ‘unconscious’, I mean those acts of human body or of different organs which do not require our awareness. But this is the only unconscious act that has inbuilt awareness. This is why many other phenomena, for example, self-relation, self-determination, self-duplication and self-annihilation become possible. The self seems to function unconsciously and unreflectively but discontinuously as it depends on our biological conditions as well. That might be the reason of not feeling this phenomenon during so-called dreamless sleep or in coma. Thirdly, it is all-pervasive, as it is believed that every moment of human existence is accompanied or permeated by self-consciousness. I propose that the self-consciousness is a highly specific human capacity, like many other ones, which originates in certain conditions and perform certain highly specific functions. In this way, such conception avoids the problem that arises in the case of dreamless sleep. I propose the self as a relational phenomenon for the following reasons: The self as a relational unity can capture and explain a complex, problematic and tense relation between the external, diversification, and the content (of consciousness) and the internal, unification and the abstraction (of the contents of consciousness) in more plausible sense in comparison to the views of the self that different traditional as well as contemporary philosophers hold. This distinction is the root of not only many of philosophical problems, like Descartes’ substance dualism, Hume’s admitting a failure to reconcile his views on the self, Kant’s problem of transcendental apperception and synthesis of empirical intuitions and conceptual categories, but the very source of the illusion in spiritual or even in philosophical sense as in Indian philosophy Shankaracharya propounds in his use of the term, ‘maya’, a notion to describe the character of external world; the error or the wrong in scientific sense and the false in logical sense. I also argue that the relation could be the best ontological category to explain the different manifestations of reality. It also seems to hold certain theoretical advantages. However, I admit that more elaborations and deep examinations of the issues related to it are required to bring clarity to the notion. I also wish to discuss some objections to my conception of the self, presented above.
Abstracts of Poster Presentations

Aspects of Consciousness and Personality with Reference to Ian Stevenson’s work: A Preliminary note

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This is a paper in progress, exploring the studies in consciousness beyond the brain. The essay is primarily based on the works by Ian Stevenson, the renowned medical scientist (psychiatrist) — *Science, The Self and Survival after Death: Selected Writings of Ian Stevenson*. Additionally, we draw briefly from Rishi Aurobindo’s *Life Divine* to explore questions like: Is consciousness only a product of brain? Is consciousness only physically determined? Can consciousness and personality exist in non-physical realm? Can we ascribe free-will as propounded by Rishi Aurobindo to consciousness and personality? If so, then does consciousness function only in the context of agency and authorship? Does the phenomenon of reincarnation prove in any way that consciousness survives beyond the brain? Stevenson convincingly argued that medicine is an imperfect science as it concentrates on techniques rather than understanding the phenomenon. For instance, while similarities exist among different disease states, there are differences among patients with similar disease. This is because medicine is no longer a holistic science and the aspects of consciousness are continuously neglected. The phenomenon of reincarnation not only proves survival of consciousness and personality beyond the brain and body but different field studies and theoretical issues indicate that the agency of self/personality is important for consciousness across time and space but not necessarily physical brain. Some case-studies of reincarnation strengthen this argument.

Effects of Anaesthesia on Animal Cognition

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Anaesthesia has been used in medical practice and basic research for over 150 years. However, surprisingly, little is known regarding its precise mode of action. Anaesthesia is an intriguing state of the brain through which one can understand a lot more about the (un)conscious state of the brain. There is a dearth of such studies in an animal model. Can anaesthetics interfere with learning processes in the brain? If yes, what is the critical period? Can classical conditioning occur in an unconscious state of deep (stage V) anaesthesia? We have tried to find answers to some of these questions using *Danio rerio* (Zebrafish), the emerging model of behavioural neurobiology. Zebrafishes are the first trained on a classical conditioning paradigm using a 9V/6cm electrical shock (US) paired with checker pattern (CS) on the bottom of a tank. The training and testing protocols are automated. In this study, two different groups of fishes will be anaesthetised, pre-training and post-training, while two other control groups will be processed similarly without the anaesthetic treatment. The effect of anaesthesia on the task-related memory will be monitored by analysing their performance in a recall test. The performance will be quantified by quantifying the position of fish in the tank and the number of turns. The analysis will be carried out using an animal tracking program written in MATLAB. In addition, we are testing the same paradigm using different anaesthesia protocols. We are also trying to record from anaesthetised and awakened animals (both invertebrate and vertebrate) to understand the differences in the coding of sensory information in anaesthetised and awake states.
Consciousness, Cognition and Culture

Does an Expression ‘Being Consciously Aware’ Make Any Sense? The Problem of ‘Cognition of Cognition’ from Indian and Western Perspectives

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When one is aware of a tree, we can say that one perceives or experiences a tree. It means also that the person has a cognition that is making him/her a conscious being. But is it possible to see a tree without being conscious of having cognition of it? Or must we be consciously aware of a tree? In other words, we can ask what makes us conscious — cognition or awareness of this cognition? Furthermore, is the latter a self-consciousness or just cognition of a higher order? There is still no single definition of consciousness in both philosophy and cognitive science. By carrying out interdisciplinary consciousness studies, we only know that there are many concepts and various levels of consciousness. In my poster presentation, I am not looking for one good theory that is assembled from them. Rather, I am going to step back to a level of ordinary language to show that the philosophical language makes distinctions that we are not accustomed to in our everyday life. The question remains whether the terms ‘consciousness of awareness’ or ‘awareness of awareness’ or ‘awareness of consciousness’ are redundant? Are ‘awareness’ and ‘consciousness’ merely synonyms or, being semantically different, or are they telling us something not trivial about consciousness? I am also asking Indian philosophers the philosophical deep meaning of disagreement in the Sanskrit world on the similar subject. On the one hand, why the logicians claim that the names — ‘awareness’, ‘cognition’, ‘consciousness’ — do not have different meanings (buddhiḥ upalabdhir-jñānamity anarthāntaram, Nyāyasūtra 1.1.15)”. Some schools, like Sāṅkhya, Yoga and especially, Advaita, would subscribe to Śankara’s idea that says "awareness is consciousness" is not intelligent and opposed to science (cittam cetanam ity etac chastra-yuktī-vivarjītam, Upadeśasāhasrī 18.88)".

Neuromodulating Cognitive Architecture: Towards Biomimetic Emotional AI

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This paper introduces the neuromodulating cognitive architecture (NEUCOGR), a new model of artificial cognitive architecture for intelligent systems. The model is biomimetically inspired and adapts the neuromodulators role of human brains into computational environments. This way we aim at achieving more efficient artificial intelligence (AI) solutions based on the biological inspiration of the deep functioning of human brain, which is highly emotional. The analysis of new data obtained from neurology, psychology philosophy and anthropology allows us to generate a mapping of monoamine neuro modulators and to apply it to computational system parameters. Artificial cognitive systems can then better perform complex tasks (regarding information selection and discrimination, attention, innovation and creativity) as well as engage in affordable emotional relationships with human users.
Do Behaviour and Consciousness Influence Social Cognition?

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Recent developments in social cognition have provided insights that human behaviour varies from person to person. The present article focuses in understanding cognitive development of individuals based on three key areas of importance: social cognition, behaviour and consciousness. Social cognition leads to remarkable progress in social perception, memory, reasoning, emotion and judgment. It provides a move ahead into social issues, such as decision making, stereotyping and cultural differences. Social cognition includes all types of developments of mind that are unique to humans and have allowed the development of consciousness, behaviour and language. It determines the nature of human conscious experience. Behaviour helps people to be aware of links between cognitions, affect and overt behaviour together with their joint consequences. Individuals need to become aware of the vague inferential approach and schemata that cause the creation and maintenance of maladaptive feelings and behaviours. The content of schemata and the process of thinking as well as overt behaviours can be engaged effectively by creating inconsistency between beliefs and behaviours and by increasing self-efficacy. Consciousness is the ability to have subjective experiences, wishes, desires, and complex thoughts to perform flexible, self-initiated, purposeful behaviours. The individuals with clear consciousness show corresponding adjustment in their behaviour. Finally, this article reveals the influence of social cognition in the understanding of behaviour and consciousness among children. The live models and symbolic models influence the behaviour of individuals.

Cognitive Abilities in Formal Operational Stagers

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The cognitive abilities are the brain based tasks namely perception, attention, memory, problem solving and decision making, etc. Perception interprets the sensations. It involves defining and recognizing the problem in a clear-cut manner. Attention, the focus of the mind to stimuli or tasks, is referred as the allocation of limited resources. Memory retains the information and is perceptually an active mental system that receives, encodes, modifies and retrieves information. Strong memory depends on health and vitality of one's brain. Problem solving is to find out the answer/solution of the confronted problem/situation. Decision making is about deciding what action to take. These are considered to be the essential tools for the welfare and meaningful existence of the individuals as well as society. Piaget theorised that individuals develop through four stages — sensorimotor, preoperational, concrete operational and formal operational stage. The formal operational stage, the fourth and final stage of cognitive development, emerges at 11 to 15 years of age. In this adolescence period, the transition from concrete to formal logical relationships occurs over time. Each adolescent develops his or her ability to think in more complex ways. Acquisition of cognitive abilities is an important goal of education for the learners. With age, some cognitive
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abilities decline, especially, the executive functions or higher order cognitive abilities. In addition, cognitive abilities that are not used regularly tend to diminish over time. This may happen at any age but is mostly observed in old age. Fortunately, these cognitive abilities can also be improved with regular practice at any age. Otherwise, time will take its toll, and the mind will lose much of its ability to function on the level one wants it to. The mind, much like the body, needs activity to keep it from going downhill before its time. Teachers play a pivotal role in enhancing these cognitive functions by encouraging the adolescents to participate in various events like debates, group discussions, collaborative learning practices and also improving the qualities such as self-confidence, exploration, firm determination and perseverance. This paper portrays the strategies to the mentors and also to the formal operational stagers to enhance cognitive abilities for effective and magnificent building of the learners.

Distorted Thinking in Cognition

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Cognitive psychology is aimed at understanding the working of mind or brain. Cognitive processes encompass sensing and perceiving, attending and remembering, and on thinking, reasoning, and problem solving. Thinking takes part an imperative role in our day to day life. In general, the more effective our thinking is, more successfully we are likely to lead our lives. But an individual, whose reasoning process that distorts reality may bring him/her to an inappropriate personality. This paper reflects the impacts of distorted thinking on every individual. The distorted thinking spoils one's views of the world and themselves. The core of distorted thinking is an irrational or senseless perception and leads to flawed assumptions and incorrect conclusions. There are three layers in our mind that occupy thinking and beliefs about our self, others and environment. Negative automatic thoughts (NATs) occupy the top layer of our thinking. NATs are easy to believe, unhelpful and difficult to stop. In the middle layer, negative assumptions link our beliefs to our day-to-day thinking. They have an interesting impact on us and our behaviour. It reflects the struggles to trigger the positive or negative core beliefs. Negative beliefs are the bottom layer of one's thinking about us, others, the world and the future. These beliefs usually develop in our childhood. These negative beliefs and thoughts are named as cognitive distortions (CDs) by Aaron Beck. CDs make one's rigid, inflexible ways of viewing the world. They are negative filters or lenses through which individuals with extensive losses tend to view their abilities. CD is also seen in individuals like perfectionists, blamers and egocentric thinkers. Blaming is a harmful action to outside sources, especially to another person, a group, or a momentary aberration, which affects an individual academically and psychologically. It is usually the work of negative or pessimistic people. They fail to see that for every situation in which blame can be placed, there is a situation in which learning and growth occur. Blaming could cost one's time, money, effort, energy, resource and most importantly, relationships and one's personal dignity. Perfectionism seems to be a CD in every human when there is some strive to do their work. However, when it exceeds a limit, it becomes neurotic and also healthy perfectionism. It is not a badge of honour to those who feel proud of it and typically confusing their talents and capabilities with their perfectionism. It interferes with a person's ability to do well. Failure to view learning and the human experience as ongoing process creates dangerous distortions. Another type of CD is egocentrism. The early adolescents show tremendous self-centeredness in their behaviour, appearance, thoughts and feelings as well as a perceived seriousness of their feelings. They are unable to differentiate easily between what others thinking about
them and their own preoccupations. They assume other people are passionate with their behaviour, appearance, thought and feelings as they are. Adolescents tend to reduce the ability to critique the construction of their own consciousness and awareness of anything outside of one's own immediate experience.

Altered States of Consciousness and Neural Correlates of Well-Being in Rajayoga Practitioners

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Meditation and spiritual practices are associated with enhanced well-being. However, meditative techniques vary widely, and the contributing factors underlying well-being are not very clear. The neural underpinnings of the benefits attained due to meditative practices are yet to be elucidated. We conducted a comprehensive survey of meditation and spiritual practices of Brahma Kumaris Rajayoga Practitioners (n = 1009, 49.2% female, age 45 ± 14.9 years) and found that proficiency in Rajayoga practice was predicted (F13,724 = 25.13, p < 0.001) by intensity and duration of practice but not by demographic variables such as age, gender, education, family income and prior religiosity, etc. Additionally, we found that proficiency in Rajayoga practice strongly predicted (F1,796 = 796, p < 0.001) a subjective sense of progress in well-being (using a scale that measured progress in happiness, peace, work-effectiveness and quality of life, etc.). Reports of altered states of consciousness and mystical experiences include ‘bodiless-ness’ (33.1%), visions (25%), trance (6.1%), ‘deep bliss’ (48.2%) and ‘immense Godly love’ (75%). We then assessed psychological and subjective well-being in a sample of subjects with long term Rajayoga practice (n = 25, 11 female, age 45 ± 9.8 years, mean 19,950 h of meditation experience) comparing with age, gender, education and income matched group with short term Rajayoga practice (n = 25, mean 971 h of meditation experience) and zero term practice (n = 25, no exposure to any meditation). As compared to subjects with no meditation experience, both subjects with long term and short term Rajayoga practice showed significantly reduced negative affect (p < 0.001), enhanced positive affect (p < 0.05), enhanced psychological well-being (p < 0.01) specifically, enhanced sense of mastery and competence and engagement and growth (both p < 0.05). Finally, we conducted a resting state functional magnetic resonance imaging (rsfMRI) study using a Siemens 3-Tesla Scanner with twenty subjects (ten each with long term and short term Rajayoga practice) from the above population with seven minutes of eyes open meditation and rest state (order was counterbalanced). As a group, the Rajayoga practitioners showed reduced functional connectivity during meditation (as compared to rest) between left frontal operculum and two other regions — the left insular cortex and the right planum polare (p < 0.05, FDR corrected). Additionally, the long term practitioners showed reduced resting functional connectivity (as compared to short term practitioners) between the left and right lateral parietal cortices (p < 0.05, FDR corrected) that are part of the default mode network. Together, our study shows that Rajayoga practitioners report a range of altered conscious states and mystical experiences, significant proficiency related progress in well-being, enhanced subjective and psychological well-being, indexed by connectivity differences between related brain network areas.
Quantum Consciousness — Critique of Penrose and Hameroff’s ‘Orch OR’ Theory
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There have been many schools of thought to address the ‘hard problem of consciousness’, i.e. to explain how and why we have qualia or phenomenal experiences. One such approach is to apply the concepts of quantum theory to explain the origin and nature of consciousness. Theoretical physicist Roger Penrose and anaesthesiologist Stuart Hameroff collaborated to propose the theory known as orchestrated objective reduction (Orch-OR). Penrose's conceptual starting point for the theory is that elementary conscious acts must be non-algorithmic, i.e. the emergence of a conscious act is a process that cannot be described algorithmically, and hence, cannot be computed. He developed this argument at length in two books using concepts such as the nature of creativity, mathematical insight, Gödel's incompleteness theorem and the idea of a Platonic reality beyond mind and matter. Penrose suggested that objective reduction represented a non-computable influence in space-time geometry from which mathematical understanding and consciousness derived. Hameroff joined Penrose to argue that microtubules in the cytoskeletons of neurons might be the physical substrate for such quantum state reductions. This proposal of microtubules as quantum computing devices has recently received support from work of Bandyopadhyay's lab at Japan, showing evidence for vibrational resonances and conductivity features in microtubules that should be expected if they are macroscopic quantum systems. In Traumatic Brain Injury and Alzheimer’s disease, microtubules — which are directly responsible for neuronal and synaptic growth, repair and plasticity — are disrupted. Hameroff and his team have claimed that usage of TUS (Transcranial Ultrasound Stimulation) promotes microtubule assembly, improves mood and cognition. Eliminative materialist philosopher, Patricia Smith Churchland, has famously remarked about Penrose's theories that "Pixie dust in the synapses is about as explanatorily powerful as quantum coherence in the microtubules." The Australian team of J.R. Reimers et al., criticised that the Orch OR theory cannot be taken seriously, because it does not specify precisely the quantum qubits without which the theory is neither self-consistent nor scientifically coherent and violates the basic tenets of good scientific practice. Combining such deep and fascinating issues, such as quantum coherence, entanglement, quantum gravity induced objective state reduction, certainly needs further work to be substantiated, and should neither be too quickly celebrated nor offhandedly dismissed. After twenty five years since its inception, the approach has fruitfully inspired many important avenues of innovative research combining quantum physics with consciousness studies.

On Being the Body Becoming: Considering the Body Animate in Agency and Memory
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This paper seeks to highlight the dynamic nature of the animate body, one that is changing itself through the experience of itself, and the role this plays in considering assumptions about body agency and its implications on perception and memory. We proceed through the world body first, forming and shaping our cognitive concepts through the embedded dynamism of a moving body in changing socio-cultural contexts. In this way, the
phenomenologically experienced body becomes universal common in human being. This review will look at the following topics: (i) The connection between static views of the body and conceptions of body agency that abound in dominant discourse: Who then is the agent? What is the difference between passivity and the body-in-static? (ii) Its role in the internalization of perceptive processes in forming memories: How can understanding the animate body as negotiating its space and time affect models of memory? (iii) The need to reconsider epistemological focus of research methodologies in social sciences: How does the body animate play a part in understanding nuances further? Drawing from psychological accounts on child development and education, anthropological accounts of cultures of movement (dance, sports), indigenous forms of art and architecture, and auto-ethnotheories of the recovering body, this review will attempt to comprehensively present a phenomenological paradigm at which transformation through movement is central.

**Sambandhatattva: As a Key Concept to Consciousness and Cognition in Classical Indian Schools of Philosophy and Theology**

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In the modern era, the problem of consciousness has drawn much attention in neurology, psychology, neuropsychology, philosophy and physics. Further, cognition, as a set of all mental abilities and processes, is analysed from different perspectives within different contexts, notably in the fields of linguistics, anaesthesia, neuroscience, psychiatry, psychology, education, philosophy, anthropology, biology, systemic and computer science. Two most fundamental questions about consciousness and cognition are — how both of them are related to each other and how mind and body are connected. However, long before the modern era, Indian philosophical and theological schools addressed these problems for about more than two thousand years ago, and the Sanskrit philosophical and theological literature on this subject is extensive. In this paper, I shall discuss *Sambandhatatattva*, the concept of relation in Indian classical schools of philosophy and theology as a key to the study of consciousness, cognition and self. *Sambandhatatattva* is a deeply rooted concept in Indian psyche. It has very wide application both in art and architectural structures of different schools of theology. In Buddhist Thangka paintings in monasteries, sculptures of *Śhivaliṅga* in temples, this concept is portrayed with different philosophical and theological perspectives. Meditative part of theological schools has represented consciousness and self with different stages of cognition in diagrammatical representations (*Yantras*). The word *Sambandha* is a Sanskrit term meaning relation and relationship. Relations are of basically two kinds — separable and inseparable. Inseparable relation is most significant to understand the relation of self and consciousness, self and cognition, and of consciousness and cognition. As *Samavāya* (a relation between inseparables), it is one of the metaphysical elements in *Vaiśeṣika* philosophy. It is a major concept in *Nyāya* epistemology and a key fundamental in theories of cause (*kāraṇa*) and effect (*kārya*) in both *Nyāya* and *Sāṅkhya* schools of philosophy. Even Advaita philosophy of non-dualism which posits all Sambandha as illusion and ignorance cannot remain untouched with this basic concept. It is a major concept in almost all classical Indian schools of theology viz. *Śaiva-Śaiva*, *Vaiṣṇava* and Buddhist. *Śaiva* and *Śaiva* theologies posit ultimate state of pure consciousness (*Paramaśiva or Parāśakti*) in blissful union of *Śiva-Śakti* — a non-dualistic state where cognition and self are united in consciousness; where three kinds of cognitive processes, knowledge, action and desire, are combined into one inner self consciousness. Likewise in Buddhist theology, blissful union of subtle mind and subtle body is the ultimate nature of self. In the latter part of this paper, I shall detail the methodology, limitations, and further possible outcomes of a wider study of this concept of *Sambandha* in classical Indian schools of philosophy and theology with special focus on consciousness, cognition and self.
Epileptic Seizure Detection Affecting Consciousness of Person: A Signal Processing Approach

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Epilepsy is the most common disease of central nervous system. According to World Health Organization, about 50 million people worldwide and 80% people from developing regions are suffering from epilepsy ("Epilepsy in the south-east Asia region bridging the gap," Report, WHO). Electroencephalogram (EEG) is one of the non-invasive techniques available for seizure detection and prediction. Consciousness is essential to normal human life. In epileptic seizures, consciousness is often transiently lost, which makes it impossible for the individual to experience or respond. These effects have huge consequences on safety, productivity, emotional health and quality of life. The brain lobe affected due to epileptic seizure shows cognitive declining of cognitive function related to that brain lobe. Abnormal function of the medial temporal lobe is expected to cause memory loss. To prevent a person to lose consciousness and from injury, it is essential to detect and predict epileptic seizures. Seizure can be focal and non-focal. Seizure detection has a lot of importance. Intra-cranial signal obtained from implantable device helps to detect and predict seizure. EEG signal processing can give vital information about which lobe is affected by seizure and will be important information before surgery. During seizure recovery, it can also provide information regarding the intensity and number of seizures occurring per day. Seizure prediction also has equal importance as this can warn a person beforehand about the probable seizure, thus helping the person to take immediate step to stop or reduce the seizure effect. This paper reviews EEG signal processing techniques that are applied directly to the signal or to the sub-bands of the signal. Wavelet transform is widely used tool for decomposition of EEG signal into various sub-bands. Empirical mode decomposition (EMD) and multichannel empirical mode decomposition (MEMD) are also used for decomposing EEG signal. Features extracted from EEG are mostly features representing complexity and entropy of the signal, Shannon entropy, Lempel Ziv complexity, symbolic entropy, sample entropy and approximate entropy to name a few. Extracted features are highest for healthy EEG signal compared to ictal EEG signal. Support vector machine classifier and artificial neural network classifier are mostly used for epileptic seizure detection. Hidden Markov model (HMM) and Bayesian belief network are used for prediction of activity. The ability of the implanted equipment to detect and predict epileptic seizure will greatly improve life of epileptic seizure patients.

An Interdisciplinary Approach to Diagnose Impaired Consciousness in Neurocognitive Disorder

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In today's scenario, 35.6 million people worldwide are living with disability due to some kind of major neurocognitive disorder (NCD) or dementia; it is the second most burdensome chronic condition in which 11.9% live with disability and 1.1% lost their lives. These numbers will be doubling every 20 years to 65.7 million by 2030 and 115.4 million by 2050 (World Alzheimer Report 2009). Actually a vital issue arises, when cognitive decline,
depression, pain, persistent grief and loss of consciousness are considered as a normal part of the aging process. The fact is that, 28 to 36 million people with dementia have not got proper diagnosis (World Alzheimer Report 2011). Major NCDs are characterised by different aspects of impaired consciousness. For instance, there is a lack of controlled processes that require conscious processing of information and such impairment is indexed by declined performances at controlled cognitive tasks. It is related to reduced brain metabolic activity in a network of frontal, posterior associative and limbic regions due to occurrence of some neurological illness, brain injury, or other medical condition. Another aspect of impaired consciousness is that NCD patients express several levels of anosognosia regarding their cognitive activities. Therefore, there is an urgent need of an interdisciplinary approach to diagnose major NCDs in elders at its early stage in order to provide treatment and complete care. This paper reviews the various interdisciplinary approaches that have been designed to assess major NCD and their causes like Alzheimer disease, fronto-temporal disorder and vascular dementia, etc. Consciousness is purely a state of high interconnectivity, and unconsciousness is brought on when the system becomes fragmented and connectivity in the brain decreases. These neurological changes, which are determined by the use of diagnostic markers (e.g., neurofibrillary tangles or senile plaque), are known as neurological models approach, which usually fails to detect the early stage of major NCD. These neurological changes induce physical changes in the brain anatomy, and these changes are detected by different analytical methods for imaging brain’s anatomy and functionality (e.g., CT-scan, PET, or MRI) that are effective to address treatment at later stages of disorder. On the other hand, electroencephalography (EEG) based approach is used to detect neurodegenerative disease at early stage. Features extracted from EEG signals, such as mutual information, correlation and fractal dimension, provide significant complexity and connectivity measure of the brain activities. Classification of these brain activities delivers a neural model, which is an alternative method for understanding and explaining these physical changes. Classification techniques, such as artificial neural network, Hidden Markov model, Bayesian classifier, are used for diagnosis of early dementia. Recently EEG based approaches for major NCD detection and prediction are widely used due to high temporal resolution, economical and portable reasons.

Consciousness of a Shaman: A Case of Korean Shamanism

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This paper reviews the studies on the field of shamanistic consciousness and tries to understand shamanistic beliefs and practices through Jungian concepts. Shamanism has been researched upon quite extensively in the past two decades. It has been defined in terms of trance, ecstasy, a healing skill, supernatural power, spirit possession, etc. The idea of altered states of consciousness came thereafter, and it was taken up primarily under a school of thought, called transpersonal psychology. Moreover, shamanism relates in many ways to Jungian concepts. Knowledge is accessed through journeying to the lower and upper worlds, where shaman’s dialogue with archetypes or power animals and spirit guides. When we give life expression through ritual and ceremony, we honour spirits and have a greater understanding of who we are. Inspired by Jung’s analytic perspective, psychologists continue to explore shamanism in order to expand and enhance the way they work with their clients, i.e. ways to expand one’s consciousness. Jungian theory finds both shamanism and analytic psychology to focus on the healing and growth of the psyche. The inner beings accessed there represent archetypal images, which are subjectively real in Jungian therapy. The symbols employed by many cultures throughout the world, were theorised by Jung to be archetypes that is a projection of one’s individuation process. Whereas shamans would
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recognize the world of spirits as a mythic part of their cosmology, an analytic psychologist would perceive a deep unconscious that is both collective and partially personalised by archetypal figures. This paper would make an attempt to examine the shamanic techniques as practiced by Korean shamans in order to understand the scientific basis, if any, of the effectiveness of shamanic techniques as a therapeutic practice from the perspective of the present day practice of psychotherapy. We will look at shamanism neither as a 'way of life' nor as a belief system or a cultural practice, but as a means to broaden our sphere of consciousness.

Smile Please! Happiness Consciousness for Better Neuroplasticity

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Happiness is something which all of us want to achieve in life, and also something about which we all know very well. However, when it comes to defining happiness, we find as many concepts and interpretations of happiness as the number of people on earth. Undoubtedly, constructivist perspective plays a dominant role in our personal perception of happiness. In simpler words, happiness depends on how we perceive and process our sensory, cognitive and emotional experiences. Research in the field of neuroscience has shown that positive feelings lead to better mental functioning which in turn improves the quality of our perceptions. As neuroplasticity (ability of the brain to develop new neurons and neuronal synapses) and positive thinking, feelings, attitudes are mutually dependent, we can achieve the state of cognitive and emotive well-being by maintaining positive, calm and happy dispositions. Furthermore, since the level of consciousness in human beings is the most developed among all living beings on earth, therefore, our perception of happiness and sadness is also much better than others. This further implies that by focussing our mental and emotional faculties more on happy and positive attributes of life and environment, we can make our happiness consciousness (individual and social) stronger than our sadness consciousness. Moreover, in the present times of inexorably increasing complexities and emotional turmoil, there is a need to focus on the development of happiness consciousness among individuals so that we may discover and appreciate brighter sides of circumstances and life. This type of attitude is also expected to nurture mindfulness and emotional development. The present paper attempts to introduce and conceptualise the term ‘Happiness Consciousness’ (HC). Various levels of HC and measures for assessing HC quotient have also been discussed in the paper. Furthermore, reflecting on the interdependence of HC and neuroplasticity, this paper also enlists certain strategies for living a happy life and spreading smiles to make this world a better place to live.
This study questions the oversimplifying dichotomy between cognition and emotion using conceptual frameworks of system dynamics and functional neurocognitive network systems (e.g., interactions between frontal lobes — executive functions and limbic system — emotion centres). We also analysed and utilised similarities between system dynamics perspective and the Buddhist concept of Pratityasamutpada — both involving multiple interdependent causal factors. The system dynamics and functional neurocognitive network perspectives suggest involved interrelations between cognitive and emotive processes, which has been supported by multiple studies (Pessoa L., 2008), and knowledge of which can be utilised for developing strategies for effective emotion and self-regulation. One major issue that is addressed is regarding applying knowledge of the interrelations between cognitive and emotive processes — including the influence of metacognitive processes — to develop strategies for emotion regulation. This was attempted by drawing from Buddhist concepts of self-training of mind (e.g., sati (mindfulness), samatha (calm abiding)) and dynamic system concepts of feedback loops, emergent control system. The paper investigates how the system dynamical interrelations between cognitive and affective processes — involving feed forward and feedback loops (e.g., prefrontal cortex, inhibitory control and emotion regulation) — combined with process of mindfulness (Satipaṭṭhāna Sutta) can be utilised for developing strategies for effective attention and emotion regulation, useful for managing emotions (Schwartz, J.M. and M.B.C.T.) Cognitive behavoural studies by A. T. Beck and others have shown that interpretation of an event influences emotional response, thus suggesting that cognitive evaluation and re-interpretation are important methods of emotion regulation. We applied system dynamics perspective (e.g., continuous reciprocal interactions) to question the dichotomy between cognition and emotion, and focus on the reverse interrelation, namely the influence of primarily emotional processes on cognitive processes (e.g., how emotionally salient stimuli influence recall). Fredrickson’s broaden and build theory of positive emotions suggests that positive emotion-states are associated with broadened cognitive and behavioural repertoire, which increases positive imagination, cognitive flexibility, thus helps in building resources for coping. We analysed the cognitive distortion of emotional reasoning and the related phenomenon of mood state dependent selective recall, noting the importance of metacognitive self-monitoring. We briefly noted the implications of system dynamics perspective of temporal variation and regulation for the variability of mental states and alterations in sense of ‘self’ (e.g., changes in self-esteem in major depressive disorders). Further, the role of metacognition in attention regulation, self-monitoring, ‘understanding’ in modulating the interrelated cognitive-emotive dynamics was examined. Here insights from Buddhist philosophy, namely Satipaṭṭhāna Sutta, Samma Ditthi and Samma Samadhi were analysed, and the interrelated concepts of ‘mindfulness’, metacognition, structural cognitive modifiability, self-directed cognitive skills training were applied to improve strategies for self-regulation. The disciplined cultivation of mindfulness may improve metacognitive skills. Clear insight into mental events (Vipassana) — associated with calm, present focused, non-reactive self-awareness — may help in better psychological integration and balance, thereby leading to better self-regulation. Given our knowledge of theories of learning, structural cognitive modifiability and neuroplasticity, self-directed cognitive training, and classical traditions emphasises on cultivating one's mind (Buddhism, Patanjali Yoga sutras) and effects of positive cognitive-emotive states, one can conclude that one should systematically cultivate positive cognitive-affective states (e.g., courage and focusing on capabilities,
The cognitive theory of emotions proposes and defends the view that emotions are necessarily dependent upon and proceeded from propositional states involving higher cognitive processing such as deliberate judgments, conscious thoughts and rationally held beliefs (Solomon, 1977, 1988, 2004; William Lyons, 1980; Anthony Kenny, 1963; Ronald De Sousa, 1987), etc. It has been proposed that cognition of some kind or the other is a necessary prerequisite for the occurrence of emotions as they can and do occur only when certain higher cognitive operations have been accomplished (Zajonc, 1980 and 1984). Despite the ease with which the cognitive theory is able to address and explain key features of emotions, such as their intentionality, rationality and classification, this way of understanding the emotion phenomenon, however, seems to be philosophically inconsistent and at odds with some of the most commonplace scientific findings. Firstly, the proposed theory is unable to give a plausible explanation of how and why emotions come to be associated with their respective expressions and bodily states (i.e. their physiology) and the unique emotion specific feelings (i.e. their phenomenology). These aspects are neglected, overlooked and ultimately, discredited as being bodily, causal, contingent, and therefore, inessential. Secondly, several counter examples demonstrate how on many occasions even the most relevant set of judgments/thoughts/beliefs is unable to either effect or prevent the occurrence of an emotion (Griffiths, 1997; Goldie, 2000). Thirdly, by defining emotions in terms of cognitions, the theory implicitly demands that the emotional subjects must be capable of engaging in higher order propositional thoughts. This demand can only be met in the case of rationally and linguistically endowed adult humans, but cannot be sustained as far as non-linguistic beings such as human infants and non-human animals are concerned. Such exclusions seem utterly unwarranted and unjustified for Darwin (2009[1890]), MacLean (1952, 1957), LeDoux (1994, 1995, 1996, 2003) and other scholars. These scholars argued that emotions are not exclusively adult human achievements. Facts about adult human emotions are evolutionarily and biologically linked to facts about infantile and animal emotions. Infants are able to respond with emotions such as sadness, joy, surprise, fear, etc., long before they acquire the ability to think propositionally or to make deliberate judgments. Similarly, many animal species too undergo the basic emotions, in spite of not having the ability to formulate higher order thoughts. Fourthly, Joseph LeDoux’s (1995, 1996) observations concerning the neural pathways to fear show that the neuroanatomical structures — the limbic system — responsible for the detection and execution of key basic emotions, but do not necessarily depend upon or include cortical processing. Finally, the fact that emotional responses can be induced directly by artificial means, such as by administering hormones, or drugs, or by electrical stimulation of relevant brain areas, also provide a strong argument against the assertion that emotions are necessarily dependent upon cognitions (Zajonc, 1980 and 1984). My primary contention in the proposed poster presentation is to show that contrary to the cognitivist proposal, having an emotion does not necessitate the presence of relevant higher order processing and propositional states. In fact, emotions can and do occur independently of cognitions, and once this fact is recognised, then the former can be studied as what they really are, sans the requirements of (and limitations set up by) rationality, propositional thoughts and linguistic ability, etc.
Being the Change, Changing the Be-ing! Gandhi, Civic engagement and Self-development for the 21st Century

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Maintaining personal well-being, which harmoniously ripples out to social well-being, is the biggest challenge of the 21st century. In the context of rapid urbanization, due to technological dependence and economic affluence, individuals of the 21st century are at a risk of developing a disconnected self that lacks intrinsic purpose — such transformation is not only in accordance with spiritual nature, rather is too dependent on materialistic possessions and public appreciation for a sense of well-being. The pursuit of inner contentment is easily replaced by longing for success and achievement in the outer world, leading to inner turmoil and mental health problems like early burn out and depression, along with social evils like corruption and lack of collective action for genuine social progress. Can the understanding of Gandhian thoughts and practice enlighten us to achieve creative viable responses to issues lying at the critical intersection of self, morality and society? “Be the change you want to see in the world” — are Mahatma Gandhi’s famous words, encapsulating his life and message. Gandhian ideas of civic engagement and self-development are interdependent and inseparable. We conducted three studies with an aim to understand Gandhian philosophy, civic engagement and their combined effects on self-development across urban and rural areas of Gujarat. All studies were qualitative in nature, and after seeking informed consent, in depth interviews were conducted with thirty youth and ten mentors who volunteered at various Gandhian institutions in Gujarat. Case profiles were prepared to explain processes of change and inner transformation that came about in individuals over a period of time.

Results from the studies highlight important elements of Gandhian philosophy relevant to contemporary times. These include rejuvenating connections with self and others through regular community meditation, sharing circles, multi faith prayers meetings, doing random acts of kindness, and building online and real time trust networks. Participants approached their civic engagement activities with maitreebhaav (an intention/ feeling of friendship) towards others to transcend distinctions of caste, class and gender, especially, in challenging situations that came up during their work. Youth volunteers particularly appreciated the value of skills to create handmade products and their understanding of money and its salience for personal well-being became more realistic. Mentors inspired youth by “being Gandhian” in their actions in everyday life, without overtly imposing any philosophy. All participants reported important inner transformations and increasing self-awareness over a period of sustained civic engagement. Other Gandhian practices of significance include becoming mindful, tolerant and using non-violent methods of resistance and negotiations with authorities, spinning the charkha, promoting the use of natural products, growing organic food, and cleaning toilets and other spaces of common utility. In conclusions, understanding the tatva (essence) and tantra (methods) of Gandhi’s philosophy and the nuances therein, is essentially a self-driven pursuit with potential to form universal, interconnected and civically engaged communities. Once the essence is internalised, the methods will evolve organically, in response to challenges faced by humanity in every century.
Can Virtual Reality Create Consciousness through Depth of Immersion

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Virtual Reality is a 3D graphic technique at the core of which lies two key properties — immersion and interactivity. Immersion reflects the fidelity with which the real world is represented, independent of human experience. Immersion is distinguished from presence — the former is not a subjective phenomenon like the latter. Presence can be assessed using electrophysiological measurements and depends on the level of immersion. It can be said that both the terms are positively correlated. The phenomenon of presence is based on the transportation of consciousness into an alternative, virtual reality so that, in a sense, presence is consciousness within that virtual reality. According to Damasio, “consciousness occurs when we can generate, automatically, the sense that a given stimulus is being perceived in a personal perspective; the sense that the stimulus is ‘owned’ by the organism involved in the perceiving; and, last but not least, the sense that the organism can act on the stimulus (or fail to do so).” If presence can be measured, then the results from the same can be extrapolated as a measure of consciousness too. Therefore, virtual reality (VR) can be used as a tool by neuroscientists to understand consciousness. In this study, we used electroencephalogram (EEG) to measure presence. A total of 10 subjects were selected for this study. A virtual park scenario was shown to the subjects in two different modes. One mode consisted of a desktop VR with low fidelity, while the second mode consisted of VR with stereoscopic goggles having high fidelity. In this research work, the user was navigated by a fly through camera function. The fly through camera function was used for free navigation without the use of a joystick. The time period of this scenario was 85 seconds. A 14 channel wireless EEG system was used to measure brain signals in both modes during navigation. In this study, a questionnaire was prepared to analyse the immersion, i.e. Immersion Questionnaires (IQ). The IQ was based on fine details of the virtual park in both the modes. After navigating through each mode, the questionnaires were given to the subjects. The four channels considered post recording were F3, F4, O1 and O2; these channels were used, because the occipital lobe and frontal lobe process visual information. In this analysis, the spontaneous alpha and gamma band activities of the brain were studied because of their crucial role in attention. The mean and standard deviation (SD) values of energy and the PSD of alpha and gamma bands were calculated corresponding to each mode. The alpha band showed reduction in immersive VR, while the gamma band showed enhancement in immersive VR. The objective score of questionnaires in both modes showed the amount of alertness. The immersive virtual reality results indicate a greater degree of immersion. In addition, it provides for more information as compared to Desktop VR. This suggests that the alertness increases in immersive virtual reality. Being more alert can be related to a better presence of mind and a higher level of consciousness of the subjects undergoing the virtual reality test.
Gone with the Mind: Thought Based Meditation and its Implications to Attention Strategies

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In the era of neuroscientific researches, as we are proceeding towards technical singularity, we are gaining insights of our brain mechanisms. Through BCI (Brain Computer Interfacing) and HSI (Human System Integration), we are largely trying to harness potential of our synaptic transmissions. Meditation and related consciousness studies are constantly loosening knots of insights of the black box, i.e. human mind. Meditation has been proven to be a boon to medical sciences as well as for gaining powerful self-regulatory mechanisms. In the present review, we hypothesize a model for a method of meditation (Rajayoga Meditation) based on generation of a thought and its propagation to utmost level of consciousness. Rajayoga meditation (RM) is being taught worldwide by Brahma Kumaris World Spiritual University. It has many classified strategies, which allow its effects to leave impressions on conscious mind, unlike defined instructions for mindfulness and concentrative meditation; RM is composed of many modes of thoughts. In the given model, attention correlates of long term meditators are presented and with their experience, it has been approached to provide insights of: how they react to any sensory cue provided; how they orient their attention to other cue; and how they became able to monitor conflict, generated due to provided cue having similar properties. Most striking are the changes lied down in their approach of reactions due to regular practice of meditation. One interesting finding has been documented relating one's intrinsic awareness with extrinsic attention. EEG data of excellent long-term meditators has been recorded with the help of Emotiv (14 channel Wireless EEG) and analysed with signal processing methods. The results show brain activation patterns, confirming stronghold of meditators on their cognitive processes. As the Rajayoga is based on positive thought incorporation and its iteration, it provides flexibility and modulates the ability to evaluate performance by meta-cognitive awareness of one's cognitive processes. With previous findings on cognitive control and attention, meditation has been found out to create holistic awareness about environmental cues with reduced arousal (Langer, 1981). However, due to reduced arousal, focal attention is reduced on specific cue, and habitual responding with many hours of meditation practice also gets reduced. Expert meditators can reverse the phenomenon of automatisation as their involvement in meditation leads to reduction in habitual cognition; the poster describes it with the help of interactive model.

The Impact of Mild Stroke and Head Injury on the Autobiographical Memory and the Self

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Autobiographical memories (AMs) are significant in maintaining a sense of self. AM is a multifaceted higher-order cognitive process involving recollection of specific personal events. It is mainly categorised into semantic AM and episodic AM. Stroke and head injury result in damaging several areas of the brain depending on the nature of injury. Studies evaluating AM separately in stroke and head injury patients have shown that AM is
affected in them. The damage to certain areas of brain responsible for AM might be the underlying cause for these AM deficits. In this study, we compared the effects of mild stroke (PCA: Posterior Cerebral Artery and MCA: Middle Cerebral Artery) and head injury on episodic and semantic AM at two different time points from the day of injury (approximately, ten days and three months). The study aims to carry out a comparative assessment of AM and self memory between stroke and head injury. We examined 15 patients and 10 healthy subjects on autobiographical incidents schedule (AIS), personal semantic memory schedule (PSMS), self-test and a few other neuropsychological tests. We found that both AM episodic and semantic memories were more affected in PCA stroke than MCA stroke and TBI. Further, when we compared deficits in AM based on the side of the brain that was affected during stroke, we noticed that AMs were more affected in patients who suffered from right MCA stroke than left MCA stroke. In contrast, AM was more affected in patients, who suffered from left PCA stroke than right PCA stroke. When episodic AM was compared on the basis of incidents in one's life, childhood memories were more affected in MCA stroke than PCA stroke and TBI. However, early adult and recent event memories were more affected in TBI than MCA stroke and PCA stroke. We compared on the basis of incidents and found that personal semantic AMs were more affected in PCA stroke than MCA and TBI. Therefore, we conclude that AM is more affected in stroke than head injury. In particular, episodic memories are more affected in MCA stroke, while personal semantic memories are more affected in PCA stroke. Our findings will give a better understanding of AM and self in stroke and head injury. The results will help in understanding the concept of AM itself in general. Additionally, this study might help in understanding the neural correlates of AM.

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A Review of Ecological Consciousness, Psychological Factors in Energy Use and Energy Conservation with the Household as a Unit for Sustainable Development

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The problem of environmental degradation has made it imperative that we make efforts to build an interdisciplinary body of knowledge on ecological consciousness. It has been noticed that even though mainstream media has been bombarding the public with information on depleting resources, there has been relatively insignificant change in human behaviour. According to Puk (2012), it may be argued neurobiologically that neuroplasticity is related to behavioural, affective and cognitive change and that after the early developmental stages, a human adult might become resistant to change as the processes of learning, unlearning and relearning are involved. However, this can also be used as an advantage by inculcating meta values such as ecologically sustainable behaviour during developing stages by employing embodiment during instruction. Moreover, an understanding of the various stages of the lifespan gives an indication regarding development of lifelong ecological consciousness. Environmental and social problems related to energy use have been a focus of much research due to policy implications and the need for introducing sustainable energy technologies. According to a review by Huijts et al. (2012), this requires a careful study of public acceptance of such technology in relation to psychological theories. Thus, factors, such as attitudes, perceived control as well as social and personal norms, need to be studied in relation to perceived costs,
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risks and benefits, feelings, trust as well as awareness of consequences. Further, according to Perlaviciute and Steg (2014), there needs to be an evaluation of costs, risks and benefits, which might occur either in contextual or psychological factors. Findings from such research can be used in intervention in order to enhance sustainable energy transitions. Within this context, the household as a unit of energy use has been researched due to its potential relevance to energy conservation. Abrahamse and Steg (2009), through the use of variables from the theory of planned behaviour and norm activation model, established that sociodemographic as well as psychological factors have an influence on energy use. It was seen that energy use was more related to sociodemographic factors, while energy use change was more related to psychological factors. Furthermore, it was observed by Hondo and Baba (2010) that the installation of photovoltaic systems in households has an influence on environmental behaviour. High awareness regarding the PV system was associated with increased environmental behaviour after installation. In addition, more communication, regarding environmental behaviour at home, was related to increased environmental behaviour. Hence, it is clear that the study of ecological consciousness and the effect of psychological factors in energy use have profound significance on human cognitive, behavioural as well as policy level research related to sustainable development when applied to the household as a unit of energy conservation.

Can Learning Empathy Increase Social Consciousness? A Controlled Game Theory Study

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Empathy denotes, at a phenomenological level of description, a sense of similarity between the feelings one experiences and those expressed by others. From a psychological perspective, empathy induces a sharing of emotions, both positive and negative, by which the probabilities of similar behaviour are increased in individuals. Empathy is closely related to prosocial behaviours. Understanding other people's emotions has adaptive advantages and is important in the formation and maintenance of social relationships. Batson (1991) has put forward an attractive empathy altruism hypothesis, which claims that the prosocial motivation evoked by empathy is directed toward the ultimate goal of increasing the welfare of the person in need. While empathy is an important value for interdependent living, most of the learning experiences of empathy take place in informal settings mainly at home or primary schooling or during social relationships. Existing research on impact of empathy on prosocial behaviours concentrates on school children at a primary level. While research on empathy among adults exists, it is mostly in informal settings. This research study attempts to understand whether learning of empathy among adults in formal settings can increase prosocial behaviour. The hypothesis that is studied is that individuals, who learn about empathy, are more prone to prosocial behaviours compared to individuals, who do not. The study is set in a formal university educational setting. The study involves a controlled experiment with groups of individuals both exposed and unexposed to learning of empathy. Along with a questionnaire survey, the study also involves understanding the performance of the groups in a game-theory based prisoner's dilemma situation. The performance is measured and analysed through statistical techniques. The aim of the paper is to thus understand the efficacy of learning empathy in a formal setting and its resultant impact on prosocial behaviours, leading to increased social consciousness.
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Aberrant Brain Functional Connectivity Patterns Underlying Experience of Auditory Hallucinations in Patients with Schizophrenia during a Visual Attention Task

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Schizophrenia, a psychiatric condition characterised by symptoms, like hallucinations, delusions, thought and speech disorder, etc., has been hypothesised to be a disconnection syndrome involving aberrant connection between brain regions involved in various higher order cognitive processes. We examined the functional connectivity (FC) disturbances underlying the experience of auditory verbal hallucination (AVH) in patients with recent-onset schizophrenia during performance of a visual attention task (VAT). We hypothesised that patients with schizophrenia having continuous AVH would show aberrant hyper-connectivity between the brain regions involved in auditory processing, which might impact FC between the brain regions involved in visual processing. For this pilot study, we designed a visual attention fMRI paradigm consisting of three conditions: free attention (FA), visual attention (VA) and hallucination attention (HA; patients only). During these three conditions, a series of abstract monochromatic visual patterns that changed at unpredictable interval was presented on the screen. During FA, subjects were asked to focus their gaze at the centre of the screen but not pay attention to anything in particular. During VA, subjects were asked to focus on the visual patterns appearing on the screen and at the end of the block indicate the number of times the pattern changed. In case of patients with schizophrenia, a third condition was introduced, wherein the subjects were asked to focus their attention on their auditory hallucinations while focusing their gaze at the centre of the screen. We performed FC analysis during FA and VA in 16 healthy subjects using Conn toolbox and compared the pattern of FC with that of 7 patients with schizophrenia who were recruited on the basis of having continuous AVH. Further, we also performed FC analysis in the above mentioned patients during HA condition. During FA and VA, healthy subjects showed increased connection strength between the brain regions that are involved in visual processing (bilateral cuneus, lingual gyrus and middle occipital gyrus). In patients, these connections were comparatively attenuated. However, the left superior temporal gyrus (SuTG), the primary auditory cortex, had strong connections with left inferior frontal gyrus (InFG) and right SuTG. The presence of strong connections — between the brain regions involved in auditory processing in patients with continuous AVH during the performance of VAT — indicate that aberrant hyper-connectivity in the above regions underlies the experience of AVH. Aberrant hyper-connectivity was further substantiated by FC analysis during the HA condition in patients with schizophrenia. Thus, we observed that aberrant hyper-connectivity in the brain regions involved in auditory processing adversely impacts the FC between brain regions involved in visual processing during the performance of VAT. Our findings indicate that the normal conscious experience is the outcome of distributed network in a particular stimulus modality. The findings also indicate that abnormal conscious experience of AVH involves aberrant connectivity in the
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Shared Goals: Referentiality and Intentionality of Coo Calls of Wild Bonnet Macaques (Macaca radiata) during Interactions with Humans

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A distinctive facet of human language is its referentiality, as is its goal of intentional communication. A close examination of referentiality and intentionality in non-human communication systems could thus provide insights into the evolution of human language. Recent studies have revealed the intentionality underlying gestural communication in several vertebrate taxa, including fish, birds and nonhuman primates. Evidence for the intentional production and use of vocal signals is, however, rare across these taxa, including nonhuman primates, though a recent study in Uganda suggests that chimpanzee alarm calls meet important criteria of intentionality. Such demonstration of intentional vocal communication in other primates, particularly monkeys, nevertheless, continues to elude us even though they share evolutionary history with hominids. We thus investigated the intentionality and referentiality underlying “coo” calls in two troops of wild bonnet macaques (Macaca radiata) in the Bandipur National Park, India. These macaques are regularly provisioned by tourists visiting the sanctuary, and several individuals were observed to ‘request’ food from humans using coo calls. Video recordings of these requests were coded and analysed to test for the presence of multiple markers of intentionality and referentiality, including social use, sensitivity to attentional states of the audience, gaze alteration and persistence. The poster will discuss the possible explanations for the differential usage of coo calls in this novel context. Our findings thus indicate, for the first time, that macaques may indeed possess the capacity to intentionally refer to human-provisioned food in specific contexts, suggesting new possibilities regarding the multimodal origin of human language.

Influence of Mood States on Information Processing During Decision Making Using Mamdani Neuro-Fuzzy System

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This study provides a comparison between traditional fuzzy reasoning tool and neuro-fuzzy system — both developed based on Mamdani approach to determine the influence of mood states on information processing during decision making. At first, participants gave their responses to questions on positive and negative prospects involving gains and losses on a health risk problem and also explained the reasons for their decisions in writing. Three independent input variables, namely flexibility, originality and fluency, were then derived from the participants’ reasons for their
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choices. Four linguistic terms, such as low, medium, high and very high, were used to represent each of the input variables. Using Mamdani approach, both traditional fuzzy reasoning tool and neuro-fuzzy system were designed for a three-inputs and one-output process. The neuro-fuzzy system was trained using back-propagation algorithm. Compared to the traditional fuzzy reasoning tool, the neuro-fuzzy system could provide better results.

The Link between Conscious and Unconscious Processes and the Artistic Creative Process

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What is the role of consciousness in human well-being? How is it connected to emotional stability? From this point of view, the creative process and the personality are the two main important characteristics of artists. An everyday element of the artistic creative process is the fluctuation of conscious and unconscious processes. How these processes follow each other or are interwoven depends on the type of creation. In the different phases of the process of creation, the emphasis of either conscious or unconscious material is present. On the other hand, artists are emotionally more sensitive compared to other populations. Because of working a lot with both conscious and unconscious materials, they have to bear such emotional states that are often difficult to handle.

In this study, we created the ‘balancing’ phenomenon in order to understand this process. Artists develop different techniques to handle the extreme emotional conditions. We recorded interviews with 120 artists from different art forms (literature, fine art and film art, etc.) related to the artistic creative process. Artists reported obviously about the continuous changing of conscious and unconscious processes. In addition, the balancing of the instable emotional conditions was reported in many cases. In my poster presentation, I shall first give an overview about the theoretical considerations related to consciousness and the artistic creative process. Finally, I shall discuss the artists’ views about the ‘balancing’ phenomenon.

Is Mind a Concept in Modern Cognitive Psychology?

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The present viewpoint is about understanding the validity of the mind as concept in modern cognitive psychology. The perspective adopted in the process of interrogating mind is psychological and deductive. However, the present article attempts to be self-reflective and critical while exploring the concept of mind. Mind as a nomological entity reflects characteristics, which has many worldviews but none has formed the consensus after years of theoretical manipulations. In one of the perspectives, mind is a creative substance that can be dealt rhetorically as happened in the cognitive psychology. Cognitive psychology, at the outset, tries to structure the elements of mind metaphorised as consciousness. This means that mind is considered as active conscious process comprising awareness, and deciphering its elements is an important task to objectify
its status as realist scientific. Since definition of mind is not predetermined and permanent, the cognitive psychology’s hesitation to go beyond the available methods limits its perspective as reductive only, if not eliminativist. The present article attempts to raise the debate between philosophy and psychology to an extent where causes are not taken for granted and emergent because of human cognitive system, but understood as connective phenomenon embedded in the sociocultural context. Thus, the measurement process of the intensity of the causes in cognitive psychology may be misleading. Hitherto, the importance of causes, which is intended mentally and connects to the outside physical world, cannot be denied.

Effect of Short Format Body-Scan Mindfulness Meditation on Cognitive Function and Affect

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Studies of mindfulness are consistent in their finding, indicating that mindfulness can serve as a therapy model to deal with many psychological and physical problems and improve well-being. Further, mindfulness is found to enhance the moment to moment experience of individuals with better clarity of phenomenon. Interestingly, most of these studies are conducted among seasoned practitioners or as long-format courses. Although long-format can be an ideal practice, it often proves to be expensive for many. Additionally, they may not be able to practise in long-format due to several reasons. Therefore, it is imperative to investigate the benefits of short-format mindfulness, exploring its utility and scalability. This experimental study examined the effect of short format mindfulness, especially on affect and cognitive function. Participants (N = 42; F = 40, M = 30) were randomly divided into an experimental group (N = 35; F = 17, M = 15) and an active control group (N = 37; F = 20, M = 17). The average ages of participants in the experimental group and the active control group were 21.79 and 21.59, respectively. Experimental group practised body-scan mindfulness — one session per day for six days, each session lasting for 25 minutes. Participants in the active control group spent an equal amount of time reading fiction of their choice and listening to soothing music. Variables that were considered include positive and negative affects, and five cognitive functions, namely psychomotor function, attention, learning, working memory-simple and social-emotional cognition. Results showed an increase in positive affect, decrease in negative affect, and increase in performance in all five cognitive functions in the experimental group with effect size ranging from mild to moderate, in comparison to active control. The study concluded that short format mindfulness practice, although may not be ideal, it might be an alternative for individuals who due to various reasons cannot practise long format courses.
Cognitive and Cultural Aspects of Academic Stress: A Review

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Rapid development in the field of science and technology have made the world more competitive. This competency has even made student life more stressful. Stressful academics have a direct impact on cognitive impairments that are usually unchecked. Indian educational system is known to impart a lot of stress among students. A thorough literature search has shown that superstitious beliefs act as moderating factors in dealing with stressful academics. Thus, the present paper encompasses the previous literature conducted till date on cognitive deficits and superstitious beliefs related to academic stress across the globe, focusing more on Indian studies. An extensive literature search with key words, such as academic stress, coping strategies and superstition, has yielded many studies. These articles were collected mainly from online databases EBSCO and ProQuest. The critical issues for future research have been identified and discussed based on the shortcomings from previous literature.

Enhancement in Cortical Alpha1 (8–10 Hz) Tuning as a Regulatory Phenomenon for Efficient Cognitive Processing among Practitioners of Vipassana Meditation

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Mindfulness or awareness is a cognitive ability that is closely connected to attention and working memory. This cognitive faculty is one of the core components, intensified with Vipassana meditative practice. P3 event related potential (ERP) is considered to reflect information processing associated with attention and memory mechanisms. Earlier studies on Vipassana practitioners have reported enhanced attentional mechanisms (as indicated by the P3 ERP component) in long term meditators. A total of 65 Vipassana meditation practitioners participated in the study. They are categorised as Vipassana teachers (who have more than 10 years of practice; conduct Vipassana courses; n = 19), senior practitioners (who have more than 7 years of practice; underwent at least one long retreat; n = 21) and novice practitioners (who have less than two years of practice; underwent one or two ten day courses; n = 23). P3 event related potential (ERP) and event-related spectral perturbation (ERSP) measures of P3 were analysed using a game based visual odd-ball cognitive paradigm called “Assessment of neuro-cognition via Gamified Experimental Logic” (‘ANGEL’), designed and standardised in our lab. EEG/ERP data was acquired using Geodesic EEG System 300 (Electrical Geodesics, Inc., USA) with 128 channel HydroCel Sensor Nets and Net Station software version 4.5.6 using Eprime 2.0 stimulus presentation software. Data analysis was performed using the ‘STUDY’ function of EEGLAB. P3 ERP shows significant increase in amplitude for rare stimuli within groups. In addition, the teachers showed significant differences in ERSP measures, especially in the 8–10Hz (alpha1) and 11–18Hz (alpha2) frequency bands.
EEG-fMRI Correlate of DMN-Microstate Quantifies Meditation Induced Altered Consciousness

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Human consciousness is considered consequent to synchronous “humming” of multiple networks that are dynamic. Conventional independent component analysis of resting functional magnetic resonance imaging (fMRI) is now considered an oversimplistic approach to understand consciousness as it time averages these dynamic networks. Using simultaneous fMRI-EEG, we aimed at overcoming this limitation to understand meditation induced altered consciousness in 40 subjects (20 meditators and 20 non-meditators). For this, we correlated resting state functional magnetic resonance imaging (rs-fMRI) derived default mode network (DMN) with electroencephalography (EEG) derived microstates. The DMN correlated EEG-microstate (DMN microstate) was quantified for its duration and occurrence. T-test and dual regression analysis were used to observe between group differences. DMN microstate was topographically similar to the resting DMN, but the average duration and occurrence of DMN microstate significantly increased (P < 0.001) during meditation induced alteration of consciousness when compared to rest. These measures also positively correlated with years of meditative experience with DMN duration reflecting the trait effect, while DMN occurrence reflecting the state effect of meditation. Thus, we conclude that fMRI-EEG derived DMN microstate could be a dynamic spatiotemporal correlate of human consciousness, and it might be used to assess disorders of consciousness.

The Alchemy of Musical Memory:
Connecting Embodiment to Imagination

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Musical memory offers a unique window into studying the role of memory in skill, creativity and consciousness. According to cognitivists, the memory system is an organised processor of information, a static store of decontextualised representations and information serving as repositories of skill and ability. While proponents of situated cognitive theories believe that memory is neither constructive nor reproductive, but a richly contextual segway between present recall and past experience. In essence, remembering musically requires the functional coupling of contextual memory with spontaneous action-based restructuring that empowers a fluid consciousness that includes the self, external symbol systems and the world. We conducted a study...
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at the New England Conservatory of Music, Boston, Massachusetts focusing on personal strategies expert improvisers use to form and process memories during musical improvisation. Using self-directed practice and performance recording methods (oral, written and video graphed), musical challenges and interviews, we tried to reconstruct how expert musicians create and use memory in improvisation. We found that musicians use contextual cues, vivid sensory affects, abstract conceptual information and symbolic cues to remember tunes, licks, phrases and musical material. Expert musicians were also capable of alchemizing their memories to create music in similar contexts and not in musical situations that provided none of the seminal symbols or cues to extemporize. Musicians used very little abstract and conceptual memory of pitches, ear training concepts and harmonic theory, but rather recollected their music making as a collage of action-based memories. They storyboarded their musical exposition as modular and programmatic reconstruction of embodied memories using a variety of multisensory strategies — from metaphors, visual patterns, synesthetic experiences, auditory imagery, invoking people, places, images and a rich tapestry of contextual information. When asked to describe the moment of creation, most of them described states of consciousness comparable to neurological ecstasy — a state of consciousness that transcended thought and linear logic. Findings from this study question the paradigm of short term and long term memory as being held in two separate cognitive ‘stores’, where only static decontextualised ability is stored as memory. Musicians, at the behest of specific musical intentions, used explicit and implicit memories, procedural, and semantic memories in an alchemical mix for improvisation, suggesting that memory is inextricably coupled to action and context. We found that memory is embodied, while it is constantly restructured and imprinted by new actions into improved cognitive schemas, thereby empowering newer vistas of imagination. The reconceptualisation of memory, in a situationist paradigm, connects embodied skill and imagination at the plexus of consciousness. Musical memory could thus be conceived as a conscious cognitive artifact that connects past action and present intention in one fluid segway of consciousness. Thus, alchemy of memory is transformative, constructivist, connectionist and definitely, situated in nature.

The Role of Consciousness in Quantum Mechanics

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The central idea of the measurement problem of quantum mechanics can be expressed in the following way: “In each and every physical attempt, only one measurement can be carried out. It seems as if ONE among the infinite possible states of any given quantum system is magically picked out and is then called reality”. This reality depends on how the observer looks, i.e. on the particular way the experiment is carried out. The process of picking out one of many possibilities is what we call ‘collapse of the wave function’. Nobody knows how the system ‘truly’ looks like, and why, whenever we look we see only one aspect. For example, a quantum entity, such as an electron, has a dual potential nature, but its actual (observed) nature is one or the other depending on the way it is measured. The intriguing aspect here is that somehow the electron ‘knows’ what the experimentalist intends to measure and then behaves accordingly. I intend to explore the underlying philosophies that tend to explain this behaviour and also signify the role of consciousness or the “observer effect” in terms of providing a comprehensive understanding. In quantum mechanics, “observation” is synonymous with the term ‘quantum measurement’. An “observer” is synonymous to a ‘measurement apparatus’, and an "observable" is understood as a measurable object. According to P.M. Dirac in ‘The Principles of Quantum Mechanics’, “A measurement always causes the system to jump into an eigenstate of the dynamical variable that is being measured, the eigenvalue this eigenstate belongs to being
equal to the result of the measurement.” Thus, measurement always plays a pivotal role in quantum mechanics; although every school of thought agrees upon the measured result as the outcome of an experiment, they tend to disagree on how and why the “Collapse of the Wave-function” happens (or does not happen in case of quantum-decoherence), depending on the various interpretations of quantum mechanics. This presentation endeavours to explore the latest works in physics and neuroscience addressing the different philosophies that highlight how consciousness may influence the “Collapse of the Wave-function” or “Decoherence”, thereby leading to a quantum measurement and a specific outcome that we call “Reality”.

Can Technology Amplify Cognitive Skill in Dyscalculics?

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The differential performance in mathematics between students with and without math difficulty has been observed over many years; however, the commitment to improving outcomes for students with math difficulty continues to grow. The term ‘dyscalculia’ is a brain-based condition that makes it hard to make sense of numbers, math concepts. The students with this condition not only encounter maths difficulty, but their mathematical achievement is also considerably below cognitive level. Most people with dyscalculia have poor visual processing and memory skills. This weakens cognitive skill such as computation, working memory, processing speed, numerical fluency, sequencing and planning. If students have fallen behind in maths due to weak cognitive skills, no amount of re-teaching the material will help. One strategy that needs additional attention involves the use of technology, designed to teach mathematical concepts in non-traditional ways. Hence, one should look for a curriculum along with the prop up of technology to develop the broad set of underlying cognitive skills that are required to efficiently and effectively learn mathematical concepts, solve problems and perform mathematical calculations faster and easier. Technology is playing an increasing role in learning mathematics. As technologies advance, they are quickly penetrating more into the daily life of ordinary people as well as into human expert domains. As technologies are used in the cognitive processes, they influence and impact the very way that acquires information and thinking, and affects the very nature of cognition. Cognitive technology can increase human mental capacity by enabling to offload cognitive operations onto technology. Such offloading reduces cognitive load, and thus frees up cognitive resources. By using technology, humans do not need to spend cognitive resources to do mathematical operations. One of the sophisticated technologies is the iPad. Tablet technologies, particularly, iPads have become ubiquitous form of learning technology and begun to permeate the way individuals learn, especially for students with dyscalculia. The affordance of many apps highlights the iPad’s potential for building students’ confidence in terms of risk taking and feeling safe to make mistakes and try again, building persistence. This in turn promotes positive effective, behavioural and cognitive skills. Finally, this article divulges how iPad technology boosts cognitive skill in learning mathematics among students with dyscalculia.
Empirical and observational studies on the cognitive abilities of nonhuman species and their underlying mechanisms developed primarily because we assume that their intelligence and, if one may use the term, mind are mostly similar to us. Through our understanding of them, we would, thus, possibly one day, understand what it is like to be essentially human. However, this view that nonhuman and human species represent a continuum in mental abilities co-existing in our minds with the equally pervasive idea that nonhuman species differ fundamentally from us because of lack of sophisticated language, and may, thus, also lack some of the capacities necessary for reasoning and abstract thought. Comparative studies on different taxa along the primate lineage may, nevertheless, throw light on the nature and evolution of different human cognitive abilities, including that elusive phenomenon — consciousness.

One particular functional perspective provides a categorisation of consciousness into perceptual consciousness — the state or faculty of being mentally conscious of anything — and reflective consciousness that refers to the recognition by the thinking subject of its own actions and mental states. Thus, if an animal were perceptually conscious, it would be able to believe, think, or remember; if, in addition, it were reflectively conscious, it would be aware of its beliefs, thoughts, or memories. Current thinking holds that some mammalian species, including higher primates, dolphins or elephants may indeed be perceptually conscious but are unlikely to be reflectively so. The principal reason for this bias against the belief that these species can reflect on their thoughts and actions is, however, methodological: people can tell us what they are aware of, but monkeys cannot.

These perspectives depend on several theoretical frameworks to investigate cognition in animals in terms of mentalistic notions. One such framework for perceptual consciousness is that of the intentional stance, which assumes that each individual is an intentional system capable of mental states like beliefs, desires and emotions. Several levels of intentionality can then be discerned, ranging from the zero level, where behaviours are entirely non-mentalistic — either simple reflex actions or learned responses — to the third level, seen in humans, where individuals have beliefs about beliefs — whether of themselves or of others. Another important functional framework encompasses attribution, whereby an individual is capable of attributing thoughts, emotions and desires to another individual. To attribute such mental states to both oneself and to others, one should have, what has been termed a theory of mind. Social animals, in particular, appear to be knowledgeable about one another’s behaviour to different extents. But do they know as much about each other’s beliefs and intentions? Are they adept at recognising the similarities and differences between their own and others’ states of mind? Behavioural decision-making processes need to be analysed carefully in order to ascertain whether true higher-order intentionality can indeed be invoked as underlying mechanisms governing such behavioural acts. An alternative, more functional, perspective of nonhuman cognition, which must be briefly mentioned here, is that of distributed cognition, which disregards the ability of an individual to have observationally invisible mental states and only recognises communicative interactions and the behavioural dynamics within the entire group as manifestation of the socio-cognitive complexity that individuals are capable of displaying.

To return to mentalism, the principal advantage that an animal enjoys — if it is able to recognise that other individuals have beliefs, which might be different from its own — is that it becomes capable of immensely more flexible and adaptive behaviour. It might then be able to manipulate another individual’s actions and beliefs in a great variety of social situations. Furthermore, if it can recognise ignorance in others, it can selectively reveal and withhold information from them. More importantly, novel information can be transmitted across individuals by a variety of social learning processes, including
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social facilitation, emulation, or imitation. These last observations raise the very important question of whether behavioural traditions or nonhuman culture, which we are increasingly documenting in a variety of social species, including monkeys, apes, dolphins and elephants, and which may be mediated by social learning, have co-evolved with complex cognitive processes in higher mammalian social systems. Ontogenetic evidence to this end comes from a few examples, such as enculturated chimpanzees, which have better imitation abilities, suggesting that learning processes may be nurtured and shaped by the culture in which they are embedded.

More complex manifestations of an ability to attribute mental states and perspectives to others would also seem to require that individuals be reflectively conscious and possess some degree of self-awareness. For individuals to clearly distinguish between their own thoughts and beliefs and those of others, for example, would obviously require some accessibility to their own minds. Current evidence for self-awareness in animals, however, seems to be patchy and inconsistent. Self-recognition refers to the ability of an animal to distinguish oneself from others without implying any awareness in doing so. Self-consciousness, in contrast, is a kind of meta-self-awareness, which implies that an individual is aware of its own state of mind and can use this awareness to predict and explain the behaviour of both oneself and of others. This distinction becomes important, because few mental processes ever become accessible to consciousness. Hence, it is possible to conceive, as seems to be evident in phenomena, such as blindsight, that an animal could recognize its own position in a social group, distinguish between its own motives and those of others, and even attribute some beliefs to others without having reflective access to its own mind.

Higher-order intentional can be effective, however, only in the presence of some degree of truly reflective consciousness. To successfully deceive an audience, for example, an individual must be able to attribute false beliefs to others, and this can be achieved only if an animal is capable of comparing its own knowledge with that of other individuals. Such a task clearly demands at least some level of self-consciousness, including an ability to be introspective.

We hope to explore, during this meeting, some of these theoretical and philosophical issues in animal cognitive psychology, ranging from mental representation to distributed cognition, from simple, possibly learnt, behavioural responses to more complex, self-based, decision-making mechanisms, ultimately leading to the current status of our understanding of higher cognitive processes and consciousness in nonhuman species vis-à-vis human beings.

Social Cognition: A “Decision Maker’s” Perspectives

Binoy V V

Let us do a thought experiment! Please recall the names of people, whom you have come across in real life and social media during the past two months. Then try to define how you are associated with each individual and recollect one interaction with him or her. Third and last step, now think how those persons are connected to each other, and where you position yourself in this large network. Too complex! Isn’t it? Interestingly, your brain collects, interpret, categorize, store relevant social information, and retrieve it whenever it is required, so effortlessly. Social cognition "attempts to understand and explain how the thoughts, feelings, and behaviour of individuals are influenced by the actual, imagined, or implied presence of others". Like social life ability for social cognition is not restricted to Homo sapiens, many species of animals are also living in societies and exhibit the ability to recognize a particular conspecific or heterospecific individual and modulate behaviours in accordance with the experience from that individual — a trait that is the corner stone of a string of social traits including hierarchy, altruism, trust, empathy as well as determinant of the social decision-making.

Our research team explores various dimensions of social cognition and factors influencing social decision-making in fish — an organism located at the base of the
tetrapod evolution. Role of acquired familiarity with con and heterospecifics species, in various contexts of social decision making by isolated individuals or groups (shoal), is one of our major focus. Additionally, the biological basis of animal personality (also referred to as individual variation in the behaviour, coping style or behavioural syndrome) and its impact on the lateralised utilization of brain hemisphere and social decision-making in fish are also being explored. Contemporary biology strongly believes that understanding neural and socio-ecological correlates of social decision making and the biological basis of consistent individual variation present in different animal species are vital not only for getting insights into the evolution of social cognition, but also for the management and conservation of their populations in natural and artificial habitats. Hence, we are planning to extend the study of this behavioural trait to other animal taxa in the near future.

Social decision-making in humans has been an evergreen topic for researchers from science, social science and philosophy. However, understanding the exact mechanism and predicting the nature of decision making by an individual or a group is not a trivial task, since any human society is not a group of individuals homogenous in their behaviour. One of the major topics in this area of research is the role of culture and personality on the decision-making, and such studies are highly important in the Indian context, because our nation is a pinnacle of social, cultural and environmental diversity. Availability of a database of cultural variation in decision-making can make social management easy and conflict free. We study the relationship between knowledge, belief systems, attitude and practices, and the modulatory role of these factors on social and environmental decision making in both children and adults from different cultures of Indian subcontinent. Development of attitude towards natural resources, nonhuman species and linkage between the cognitive style and decision-making are the specific topics we follow.

It is uncontested that Autobiographical Memory (AM), the remembrance of personal experiences integrated into an overarching life narrative could regulate the decision-making of an individual. AM is a determinant of the four vital element of human behaviour: personal identity, problem solving capacity, emotional control and relationship management. Additionally, this form of memory is a window to “autonoetic consciousness — the human ability to mentally place themselves in the past, in the future, or in counterfactual situations, and to analyse their own thoughts”. AM can put mark on implicit, explicit and intuitive representation of self and personality traits of an individual, and thus her/his psychological well-being. Like many other cognitive traits, characteristics of AM vary from culture to culture. Our research on AM focuses on the cultural divergence in the development of various properties of this form of remembrance and Meta-autobiographic Memory (MAM). The role of AM and MAM in determining the representation of the various dimensions of self, personality traits and social decision making, and its modification during different neuropsychopathological conditions also comes under the scope of our research.
The Neuroscience Approach to Understanding Consciousness

Nithin Nagaraj

**Brain: The Final Frontier**

As you read these very words, you are receiving a rich variety of sensory signals — sound pressure at your eardrum, light intensity falling on your retina, sensations from the tip of your toe — all reaching your brain through voltage pulses called action potentials or ‘spikes’ transmitted via millions of sensory neurons. Brain, considered to be the seat of Mind and Consciousness, is in many ways the final frontier of scientific research. Theoretical or computational neuroscience aims to study how our brain encodes, performs computations, and then decodes information from these ‘spikes’ in order to represent, interpret and understand the sensory world and to initiate suitable actions (e.g., to move muscles in your eye for changing the position of the eyeball) via information transmitted from the brain to the motor neurons. The starting point of this study was the 1920s ground-breaking experiments of E. D. Adrian, who was the first to employ sensitive instruments to record from single axons of sensory receptor neurons (the first neurons, he recorded, were from stretch receptors in the muscle of the frog). These neurological signals, or ‘spike sequences’ are the language of the brain and nervous system, both for its internal communication and computation and for external interaction with the outside world.

**The Central Questions**

Some of the central questions addressed by neuroscience are as follows: (1) How is information of the continuously varying external stimulus encoded (neural code) in to a ‘spike sequence’? (2) What is the information rate and coding efficiency of this neural encoding? (3) How does the brain perform computation on these neurological signals? (4) Natural conditions impose a lot of noise on the ‘spike sequence’ — in such a scenario, how are encoding, processing and transmission performed with high reliability without error? (5) Given the sheer complexity of the number of neurons and their interconnections, how does such a highly complex, noisy network function to yield (largely) consistent response and behavioural decisions from the organism? (6) How does memory play a role in all this? (7) Last and the most important — how does all this translate to the larger question of Mind and Consciousness?

In the last half a century, answers to the above questions have been actively sought by researchers employing methods from diverse fields: (this is not an exhaustive list) Information theory (Shannon entropy, mutual information and channel capacity); Complex systems (chaos and non-linear dynamics, synchronization of network of neurons, “neurochaos”, etc.); Computer Science (Henk Barendregt et al. proposed a computational model of consciousness known as human hybrid universal Turing machine); Quantum Mechanics (see thematic note by B V Sreekantan and Sisir Roy); Psychology; and Philosophy (see thematic note by Sangeetha Menon). While there has been a lot of progress towards finding answers to these questions, these are far from being settled and continues to be a hot field of active and exciting research. Given the various approaches as listed above, it is only logical that the most successful program would be one of a multi-disciplinary nature, resonating with the theme of this ‘Conference.’ The research teams in neuroscience of today and tomorrow are made up of neurologists, electrical engineers, computer scientists, medical imaging researchers, physicists, psychiatrists, psychologists, neurosurgeons, mathematicians and philosophers (and not to forget animals and human volunteers for brain studies).

**Where Are We Today?**

Neuroscience has come a long way since the papyrus containing description of 48 cases related to the brain, written by an Egyptian surgeon thousands of years ago (an American Egyptologist named Edwin Smith first discovered this papyrus in 1862 AD). The Spanish Nobel laureate Santiago Cajal established the central tenet of modern neuroscience in 1889 — the ‘neuron doctrine’: that the nervous system is composed of discrete individual nerve cells which are independent elements (the term ‘neuron’ was coined by the German anatomist...
Wilhelm von Waldeyer in 1891 AD). Localism (the view that neurons and brain areas have specific functions) and holism (neurons work more as aggregate field) is now being replaced by “connectionism”. This view contends that lower level functions (primary sensory/motor functions) are strongly localised, but higher-level functions (object recognition, memory and language) are the results of interconnections between different brain areas. In addition, even within areas that seem to be localised for a particular function, that particular function is found to be distributed among many neurons. The Human Connectome project, sponsored by National Institute of Health (NIH, USA), by means of advanced high-field imaging technologies and neurocognitive tests attempts to construct a map of the complete structural and functional neural connections in vivo within and across individuals. This will produce a huge compilation of neural data from living human brains, which will facilitate enhancing our understanding of the relationship between brain connectivity and behaviour, and also paving the way for research into brain disorders such as dyslexia, autism, Alzheimer’s disease and schizophrenia.

Brain-machine interfaces, high speed computing and virtual reality have enabled concrete scientific investigations into understanding how the brain creates a perception of reality and the mechanism of decision making in the brain. Brain-Computer and Brain-to-Brain interfaces have enabled unique insights into the workings of the brain for understanding cognition and for restoring and augmenting brain function (Rajesh Rao et al.). Virtual reality based studies (Mayank Mehta et al.) have addressed specifically how the brain creates perception of abstract space and time.

**Neuro-Imaging, Brain Disorders and Consciousness Study**

The advent of new functional neuro-imaging technologies such as magnetoencephalography (MEG), which maps brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using highly sensitive magnetometers and the classical functional-Magnetic Resonance Imaging (fMRI), not only are they useful for localising brain regions that are pathological for surgical removal, these technologies are becoming increasingly useful for basic research into perceptual and cognitive brain processes, determining the function of various parts of the brain and for experimental neuro-feedback. Since its inception over twenty years ago, fMRI together with other measures of brain physiology (such as EEG) is increasingly being used for treating neurological disorders. These technologies enable to map functional areas of understanding and lateralization of language and memory in the brain, so that surgeons can avoid removing critical brain regions when they operate on brain tumours and lesions.

However, there has been no progress in finding any region or structure of the brain that explains our own experience of a continuous, consistent, integrated and conscious “Self”. Even to understand what determines subjective conscious experiences (qualia) has remained elusive to neuroscience.

**End-Note**

Is the Mind completely “created” by the Brain? Can Consciousness be reduced to Neurons and their activities? Is there a “Soul or Self” that exists beyond the Neurons? These questions continue to be hotly debated even today.
The advancement of quantum theory clearly shows it as a successful framework to explain the behaviour of the entities of microscopic world and even some cosmic phenomena. On the other hand, the researchers have not been able to reach a consensus on its interpretation and not even an agreement on the significance of the "weird" properties like "non-locality", "indeterminism" and "incommensurability" at the microscopic world. It is also not completely clear whether the "so-called measurement problem" or the "issue of classicality" are conceptual issues or "artefacts" of particular interpretation. This has given rise to longstanding debate for more than six decades on the issue of "local realism" as propounded by Einstein — where "probability" plays an epistemic role and the concept of "indeterminacy" by Heisenberg in which the probability as ontic one.

The main problem in quantum theory is related to the observations, i.e. how one of the possible values be realised in practice — starting from a superposition of possible vectors, each representing the quantity to be observed having one of its possible values, known as the "reduction of wave packet" in quantum theory. This baffled many scientists since the very inception of quantum theory. Schrodinger himself described it in his "Cat paradox" popularly known as "Schrodinger cat paradox". Scientists, like Wigner, Pauli, Stapp and others, also tried to understand the phenomenon of reduction of wave function and its relation to consciousness or psyche. Penrose et al. proposed that the reduction is due to gravitational field associated to micro-tubules in the brain. However, no definite formalism emerges from these attempts so that one can include the role of conscious activities of the observer in the formalism of quantum theory.

It is amazing to note that the progress of quantum theory puts the observer and the observed in a tight and unexpected linkage in the world of modern science. The quantum principle has demolished the age old belief that the universe sits safely "out there". One needs an instrument to measure the position of an object in the universe — at any level of its hierarchy from macroscopic to microscopic level. However, the measurement for a tiny object, like electron, is a puzzling situation. The installation of the instrument for the measurement of the position of an electron excludes the installation of an instrument to measure the momentum of the electron at the same time. The observer needs to decide which one he or she wants to perform depending on the requirement. This leads to change our views and put forward the word "participator" instead of the "observer" in all matters relating to the universe as emphasised by Wheeler.

It is worth mentioning that the physical substratum of everything in the universe is one entity, called 'quantum vacuum'. To establish that all matter and all physical phenomena, including aspects of life and consciousness, arise from empty space or quantum vacuum, the scientists had to carry out a whole sequence of reductionist experiments and also resort to the insights from unconventional theories particularly in 20th century.

In 1935, Einstein, Podolsky and Rosen proposed a "Gadenkin experiment" in which they challenged the completeness of quantum theory in understanding the reality at microscopic domain. They emphasised that one should consider the distinction between the objective reality that is independent of the observer and the physical concepts used in any physical theory. This gave rise to a "great debate" — "Einstein-Bohr" debate in 20th century on the issue of quantum reality and the ontological issues.

Shimony, Busch and co-workers proposed a more realistic interpretation known as "propensity" to understand the observation process and quantum reality. According to this interpretation, the property associated with microscopic entity manifests as an element of reality by its tendency to become actualised under specific measurement condition. Here, the probability is nothing but the quantification of the potentiality of a property. This interpretation of probability as a degree of reality helps us not only to understand the reality in microscopic domain but also the limit of classicality.
Self and Consciousness

Sangeetha Menon

The amalgamation of neurobiology, neuropsychiatry and philosophy has brought light to the biologically ridden body on one side and the delicate nature of the personhood on the other. What is strikingly interesting — if we span the discoveries and path-breaking studies in the last decade in neuroscience, neurochemistry and neuropsychiatry — is how the human personhood has resurfaced as an important factor that needs inclusion and explanation in a scientific manner. In the recent times, it is with equal gusto that descriptions and presentations are made about the cognitive processes, emotional valences and most importantly, considering experience as an integral whole, in the alleys of science. Self is the puzzle for twenty-first century biology as well as for consciousness studies.

It was not too distant in the past that human experience and the subjectivity of the person were anathema for empirical sciences. The keywords that ruled a biologist’s imagination were inspired by the functional roles played by genetics and the physiology of the body until the recent past. Such a stance was confronted a few decades back, and the qualitative attributes of experience and the personhood were brought into the lab to search for possible empirical convertibles and biological correlates. In this ongoing trend, the first and foremost entrant is cognitive sciences. Cognitive sciences started with the agenda of explaining the act of seeing in vision, and such perceptual endowments that humans and animals possess. It was soon found that it is crucial to understand the intelligence behind the act of perceptions to justify the variations and differences in capabilities that individuals exhibit while interacting with the environment. Thus, ‘mind’ came into the forefront through the backdoor once again from the exclusive grips of philosophy and psychology. Along with the mind came in the new avatar of the body which is not completely biological but partly conceptual and representative.

Theories of embodiment available today in plenty in the discourse on mind, and cognitive capabilities have re-fashioned the ways in which the good old ‘body’ that classical biology was familiar with. The concept of the body in cognitive sciences is an extremely fascinating subject that has extended from the blood and flesh of the anatomical body to objects that we desire and possess, capabilities that we can ‘afford’, and most importantly, to the self that inheres the body — which means, the difference and distance between the traditional ideas about the body and the body-dweller is dwindling. The body is the subject and the living person. What is bereft of the body is given embodiment with the powerful structures of phenomenology which endorse experiences that are lived and are alive at all moments.

The impact of the body-phenomenology on sciences is such that emotions and psychological dispositions such as compassion have come to be regarded as significant in explaining the human self and its affective expressions. The affective sciences are today in par with the cognitive sciences to accommodate those tendencies of the human that was once considered to be working against rational behaviour and appropriate decision making procedures. The study of emotions and their place in the geography of the human self have also taken the alliance of the brain, its structures and neurochemical functions to present viable theories both within and outside the evolutionary context.

What does all this mean to that erstwhile philosophical gold mine of the ‘self’? Is philosophy side-lined in the pursuit of the undisclosed engravings of the ‘who’ and the ‘what’ of the human self? Why have the body and embodiment become favourites of cognitive sciences to explain human capabilities? By bringing the body from the dark corners of the pre-renaissance age to the modern show-light of cognitive sciences and information systems have we pawned a few physical attributes of the body and added a few non-physical functions on to it? Is the new avatar of body taking away what is central to the existence of the self? In other words, is the ‘body’ of the recent times exhuming the self from the ancient times of metaphysics but only to lead to its extinction?
These and many other tributary questions can be approached only if we bring into our focus the role of the interrelations between the brain and the self to chart the paths of consciousness and lead to the unknown and unimagined spaces of the possibilities of the human self. It is no more possible to have exclusivist presentations about the brain and the self if what we look for is the complex ways in which the human self is endowed.

Often the ‘self’ is conceived and conceptualised in the form of ‘the self’ or ‘your self’ or ‘someone’s self’. The form ‘my self’ is hard to be seen in cognitive sciences’ repertoire. Once we accommodate the notion of self as ‘my self’, the detached and impersonal disregard for the self will reduce, and we will start talking about a living self, which is you and me. This is the greatest difficulty faced by sciences such as neuropsychiatry. Because there is a lack of involved participation (of course the practice of science cannot be involved to begin with!), even the most intimate subject of enquiry, the self, is overlooked particularly of its influence on every single person — even the person who is engaged in scientific enquiry. If at all such an intimate self is recognised, with no time spared, it is dismissed as a fleeting, promiscuous self who is the illegitimate child of sociolinguistics or the information processing systems that is embedded in our brains.

The immediate availability of the bodily-self takes the centre stage of one’s reflection to acquire closeness to one’s identity. The body that inhabits the changing self becomes the self of the person. The physical body is governed by the principles of chemistry and biology. But when I and my body interact with the environment (the outside world of people, relations and objects), I am not worried or even thinking (unless one is a hypochondriac) how the chemical processes are being executed in the body. What I think about are my feelings and thoughts that are directed from and to objects, people and relations. The physiology and anatomy of the body that is anyway concealed to me because of the gift of the human skin is a non-event for me. At the same time, somehow the brain and the body shroud the nitty-gritty of electrochemical processes with a unique biologically uncharacteristic feeling of I and me.

First, I am the one who thinks, feels and responds. Primarily, it is the thinking that a person relates to the body and is aware of the body. Subsequently, the feeling comes that I have a body. There is significant difference between the implications of a being self and a having self.

The discussions on consciousness are yet to highlight this distinction that is basic to our experience. The experiential primacy of the self is closely tied up with our ability to reflect and introspect. While the brain might have a big say in deciding our states of waking, dreaming, conscious and unconscious states, it is the experiential self that has the capability to dive deeper and reflect in complex and focused manners. The notion of “pure experience” is important in conceptualising subjectivity and methods to investigate it.

Consciousness studies, today, are excited by several challenges commencing from explaining the origin of consciousness, the nature of self, personal identity and role of self-transformation, to list a few. Among all these challenges, the two most important questions that baffle us are: How does the brain challenge the self and the self challenge the brain? How is the conspiracy of ‘experience’ and the ‘experiencer’ created by the self-challenged-by-the-brain and the brain-challenged-by-the-self?
CONFERENCE PROGRAMME
Consciousness, Cognition and Culture: Implications for the 21st Century
JRD Tata Auditorium, NIAS, December 9 to 11, 2015

**PROGRAMME**

**Wednesday, 9 December 2015**

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>9.10 – 9.15 am</td>
<td>Prayer – Naresh Keerthi</td>
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<td>9.15 – 9.20 am</td>
<td>Welcome and Opening Remarks – Baldev Raj (Director, NIAS)</td>
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<tr>
<td>9.20 – 9.25 am</td>
<td>About NIAS Consciousness Studies Programme and Goals of the Conference – Sangeetha Menon</td>
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**Session 1: Cognition and Consciousness Across Species**
Chairperson: Anindya Sinha

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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| 9.30 – 10.10 am| Tetsuro Matsuzawa  
Evolutionary Origins of Human Mind Viewed from the Study of Chimpanzees                |
| 10.10 – 10.50 am| James Bower  
Sniffing the World: The Influence of the Olfactory system on the Evolution of Cerebral Cortex and the Structure of Human Cognition |
| 10.50 – 11.20 am| Soumya Iyengar  
Avian Cognition — From the Perspective of Neuroscience and Behaviour                    |
| 11.20 am – 12.00 pm| Binoy V V  
Animal Consciousness: Some ‘Fishy’ Facts                                                    |
| 12.00 – 12.40 pm| Open Discussion with Q & A                                                                       |
| 1.10 – 1.15 pm| Closing Remarks by the Chairperson                                                             |

**Session 2: Agency, Information and Brain-Computer Interfaces**
Chairperson: John P John

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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| 2.15 – 2.55 pm| Mayank Mehta  
How Neurons Create Perception of Reality: Lessons from Virtual Reality                      |
| 2.55 – 3.35 pm| Rajesh Rao  
Understanding Cognition through Bayesian Models and Brain-Computer Interfaces               |

1.15 – 2.15 pm LUNCH
<table>
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<th>Time</th>
<th>Session/Activity</th>
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<tr>
<td>3.35 – 4.05 pm</td>
<td>TEA/COFFEE</td>
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| 4.05 – 4.45 pm | Nithin Nagaraj  
*Entropy and the Neuron: Insights from Information Theory* |
| 4.45 – 5.15 pm | Narayanan Srinivasan  
*Hierarchical Event Control and Agency* |
| 5.15 – 5.45 pm | Open Discussion with Q & A                                                       |
| 5.45 – 5.50 pm | Closing Remarks by the Chairperson                                              |
| **SESSION 3: POSTER SESSION**  
(Venue: Faculty Block Building, Atrium) |                                                                 |
| 6.00 – 7.00 pm |                                                                 |
| 6.30 – 7.00 pm | TEA/COFFEE                                                                        |
| **SESSION 4: EVENING PUBLIC LECTURE**  
Chairperson: Anindya Sinha |                                                                 |
| 7.00 – 7.40 pm | Lecture by Miguel Nicolelis  
*The Relativistic Brain: How It Works and Why It cannot be Simulated by a Turing Machine* |
| 7.40 – 8.00 pm | Open Discussion with Q & A & Closing Remarks by the Chairperson                  |

**Thursday, 10 December 2015**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Activity</th>
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| 9.30 – 10.10 am | John P John  
*Auditory Hallucinations in Schizophrenia: A Window to the Conscious Self and Its Aberrations* |
| 10.10 – 10.50 am | Prathibha Karanth  
*Children with Autism Spectrum Disorders: A Case for 'Alternate Selves'?* |
| 10.50 – 11.20 am | TEA/COFFEE                                                                        |
| 11.20 am – 12.00 pm | Naren Rao  
*Metacognitive Dysfunction in Schizophrenia: Neural Correlates of Self vs. Other's Thinking* |
| 12.00 – 12.40 pm | Owen Flanagan  
*A Dozen Cross-Cultural Variations in Self-Consciousness* |
| 12.40 – 1.10 pm | Open Discussion with Q & A                                                       |
| 1.10 – 1.15 pm | Closing Remarks by the Chairperson                                              |
| 1.15 – 2.15 pm | LUNCH                                                                            |
| **SESSION 6: ARGUING FOR PURE EXPERIENCE**  
Chairperson: Owen Flanagan |                                                                 |
| 2.15 – 2.55 pm | Stephen Post  
*Consciousness, Mind and the Deeply Forgetful* |
| 2.55 – 3.35 pm | Viktoria Lysenko  
*The Problem of Qualia in the Perspective of the Buddhist Theory of Consciousness.* |
### Consciousness, Cognition and Culture

#### Session 7: Evening Public Lecture
**Chairperson: Naren Rao**

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<th>Time</th>
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| 5.30 – 6.10 pm | Lecture by Georg Northoff  
*What Brain Imaging can tell us about Self and Consciousness?* |
| 6.10 – 6.30 pm | Open Discussion with Q & A & Closing Remarks by the Chairperson      |
| 6.30 – 7.00 pm | TEA/COFFEE                                                            |

**Evening Cultural Programme**

*India — From Tradition to Modernity*

Performance by Madhu Nataraj Kiran and Natya Stem Dance Kampni, which encompasses the classical, folk, martial art forms and contemporary Indian dance heritage in a mosaic imagery, where original music, multimedia and costume design meet Dance.

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**Friday, 11 December 2015**

#### Session 8: Social cognition, Imagination and Meditation
**Chairperson: Narayanan Srinivasan**

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<tr>
<th>Time</th>
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| 9.30 – 10.10 am| Shatavadhani R Ganesh  
*Emotions and Imagination working behind Expression* |
| 10.10 – 10.50 am| Bindu Kutty  
*Brain, Cognitive Reserve and Neural Basis of Consciousness* |
| 10.50 – 11.20 am| TEA/COFFEE                                                           |
| 11.20 am – 12.00 pm | Jamuna Rajeswaran  
*Creativity and Cognition: Neuroscience Perspective* |
| 12.00 – 12.40 pm | Frank Krueger  
*The Emerging Neuroscience of Third-Party Punishment* |
| 12.40 – 1.10 pm | Open Discussion with Q & A                                          |
| 1.10 – 1.15 pm | Closing Remarks by the Chairperson                                  |

#### Session 9: Realism, Physics and Mathematics
**Chairperson: Michel Bitbol**

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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| 2.15 – 2.55 pm | Ralph Abraham  
*Mathematics and Mysticism* |
| 2.55 – 3.35 pm | Henk Barendregt  
*Deconditioning the Mind by Insight into Absolute Conditioning – An Approach from Universal Computability* |
### Conference Programme

<table>
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<tr>
<td>3.35 – 4.00 pm</td>
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<tr>
<td>4.00 – 4.40 pm</td>
<td>Partha Ghose</td>
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<td><em>Realism in Quantum Theory and the Role of Human Experience in Apprehending Reality</em></td>
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<td>4.40 – 5.10 pm</td>
<td>Giuseppe Vitiello</td>
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<td><em>My Double, the Arrow of time and consciousness</em></td>
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<tr>
<td>5.10 – 5.40 pm</td>
<td>Open Discussion with Q &amp; A</td>
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<tr>
<td>5.40 – 5.45 pm</td>
<td>Closing Remarks by the Chairperson</td>
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<tr>
<td>6.00 – 6.30 pm</td>
<td>TEA/COFFEE</td>
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<td><strong>Session 10: Evening Public Lecture</strong></td>
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<td><strong>Chairperson: Viktoria Lysenko</strong></td>
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<tr>
<td>6.30 – 7.10 pm</td>
<td>Lecture by VN Jha</td>
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<td><em>Matter and Consciousness in Indian Philosophical Analysis</em></td>
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<tr>
<td>7.10 – 7.30 pm</td>
<td>Open Discussion with Q &amp; A</td>
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<td>&amp; Closing Remarks by the Chairperson</td>
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**Saturday, 12 December 2015, 9.30 am to 1.00 pm**

Half day Symposium and Panel Discussion on *Reality in Modern Physics and Classical Traditions*

**Chairperson:** BV Sreekantan  
**Moderators:** Sisir Roy and Shivanand Kanavi  
**Panellists:** HR Nagendra, Swami Atmapriyananda, Geshe Dorji Damdul, Madhu Khanna and Narendra Bhandari
BIOGRAPHIES
Tetsuro Matsuzawa is Professor of Kyoto University, Japan. He belongs to Section of Language and Intelligence, Department of Cognitive Science, Primate Research Institute. Matsuzawa is the current president of the International Primatological Society. He is also the General Director, Japan Monkey Centre and the Editor-in-chief, PRIMATES — the oldest journal in English in the discipline of Primatology. He is also on the Editorial Board, The Royal Society, Philosophical Transaction B, UK. He is also the Chair, Scientific Program of International Congress of Psychology 2016, held in Yokohama, Japan. Matsuzawa was born in 1950 in Japan. He entered Kyoto University in 1969. His first major was Philosophy, later he moved to Psychology. He got the tenured Assistant position in Primate Research Institute in 1976 when he was in the middle of the graduate course of Kyoto University. He obtained his PhD (Science) in 1986 from Kyoto University. During the period 1976-present: Matsuzawa has been affiliated to Primate Research Institute of Kyoto University (1976: Assistant professor, 1987: Associate professor, 1993: full professor, 2006-2012: Director). His current major is Primatology, especially establishing a new discipline, Comparative Cognitive Science. Matsuzawa has been studying chimpanzee mind both in the laboratory and in the wild. The laboratory work is known as “Ai-project” since 1976. He has also been studying the tool use in the wild chimpanzees at Bossou-Nimba, Guinea, West Africa, since 1986. Matsuzawa tries to synthesize the field and the lab work to understand the nature of chimpanzees. He published journal papers and also the books such as “Primate Origins of human cognition and behaviour”, “Cognitive development in chimpanzees”, “The chimpanzees of Bossou and Nimba”, from Springer. He received several prizes including Prince Chichibu Memorial Award for Science in 1991, Jane Goodall Award in 2001, The Medal with Purple Ribbon in 2004 and the Person of Cultural Merit in 2013.

Dr. James M Bower is a graduate of Montana State University (BS-Zoology) and the University of Wisconsin, Madison (Ph.D. in Neurophysiology). He was a postdoctoral fellow, worked under Dr. Rodolfo Llinas in the Department of Physiology and Biophysics at New York University Medical Centre. Dr. Bower advanced from a junior faculty member to full professor with tenure at the California Institute of Technology before moving to a tenured faculty position in the University of Texas System. Since retiring from the UT System in 2013, Dr. Bower maintains visiting faculty appointments in several different universities around the world.

Dr. Bower’s scientific research has always been focused on understanding how information is processed by the neuronal circuitry present in cortical structures of the mammalian brain. This work involves both the cerebellum and the olfactory system and employs a diverse set of experimental techniques including anatomy, physiology and behaviour, as well as human imaging and psychophysical studies. All experimental work is undertaken in the context of anatomically and physiologically realistic computer simulations of the relevant neurons and circuits. With respect to support of the profession, Dr. Bower’s laboratory is the principle developer of the GENESIS simulation system used around the world to make realistic neural models. Dr. Bower is the founder member of the Journal of Computational Neuroscience. He was the principle organizer of the annual international CNS meeting for the first 10 years. Moreover, he was the founder and co-director of the first Methods in
Soumya Iyengar obtained PhD degree from the University of Southern California, Los Angeles, USA, where she worked on the development and organization of the anterior forebrain pathway, which is important for song learning in songbirds (zebra finches) using neuroanatomical tract tracing techniques. Later, she worked as a postdoctoral fellow in Prof. Jon Kaas’s lab (Vanderbilt University, Nashville, USA) on delineating the connections of the representation of the oral cavity in the somatosensory cortex of new world monkeys. She has been working in National Brain Research Centre (NBRC), Manesar, India since 2003 and is currently an Additional Professor at NBRC in the Systems Neuroscience division. Her laboratory works on the role of the opioid system on the acquisition of birdsong, adult neurogenesis and behaviour in zebra finches. Additionally, she is interested in linking various aspects of brain structure and cognition in corvids (house crows) as well as in studying the development of the human auditory cortex using neuroanatomical techniques.

Binoy is currently an Assistant Professor at National Institute of Advanced Studies (NIAS), Bengaluru India. Besides his research on social decision-making and personality traits in both animals and humans, he is also interested in popularizing science using non-conventional methodologies of communication. He also studies the efficacy of ‘citizen science’ in data collection and dissemination of knowledge in a multi-stakeholder society (http://www.nias.res.in/wash/).

Binoy has a master's degree in Zoology and he has also earned a doctorate degree. He has been a recipient of the ‘Cognitive Science Research Initiative Postdoctoral Fellowship’ and ‘Young Scientist’ fellowship, a start-up research grant from the Department of Science and Technology, Government of India. He is a research affiliate at the Krasnow Institute for Advanced Study and the Centre for the Study of Neuroeconomics, George Mason University, USA. Binoy is also passionate about Yoga, meditation and Asian martial arts and has been a keen practitioner. For further details, visit https://sites.google.com/site/vvbinoy/.
Mayank Mehta, a Professor in the Departments of Physics & Astronomy and Neurology, directs the Keck Centre for Neurophysics at UCLA, USA. He earned his PhD in quantum field theory, studying the effects of quantum fluctuations on structure of space-time. While these theories are fascinating, the lack of experimental verification is frustrating. Hence, from his postdoctoral studies onwards, he has focused on understanding how neurons create perception of space-time and developing experimental tests of his theories.

In particular, the goal of Prof. Mehta's research is to understand how cellular properties shape interactions of ensembles of neurons, and how cognition emerges from the emergent dynamics of biophysical neural networks. Prof. Mehta's group use a combination of in vivo electrophysiology of ensembles of single units from multiple brain regions, whole cell measurements in vivo, novel data analysis methods and biophysical computational modelling to address these questions. They also develop hardware and software for experimental control. This combination of theory and experiments has been quite fruitful. Examples of some important questions, where Prof. Mehta's research group has made significant progress are: How do networks learn causality? How does a biophysical network learn and predict event sequences? How does one determine the functional connectivity between large neural networks in vivo? How do neural networks represent the speed of stimuli using brain rhythms? How do noisy networks generate the precise spike timing necessary for learning and memory using brain rhythms? How does the brain generate the up-down state oscillations during sleep and how do these sleep oscillations influence learning and memory? How does the brain put together multisensory stimuli to generate a coherent percept? How do neuronal dendrites influence synaptic plasticity and neural information processing? Prof. Mehta's group has not only developed biophysical theories to address these questions but also tested these theories experimentally. Although there is a long way to go to fully resolve these questions, the results so far have provided significant insights. For further details, visit http://www.physics.ucla.edu/~mayank/.

Rajesh P. N. Rao is the Director of the NSF Engineering Research Centre for Sensorimotor Neural Engineering and Professor of Computer Science and Engineering at the University of Washington, USA. He is the recipient of a Fulbright Scholar award, an NSF CAREER award, a Young Investigator Award from the Office of Naval Research, a Sloan Faculty Fellowship and a Packard Fellowship for Science and Engineering. He is the author of the book Brain-Computer Interfacing (Cambridge University Press, 2013) and the co-editor of two volumes, Probabilistic Models of the Brain (MIT Press, 2002) and Bayesian Brain (MIT Press, 2007).

His research spans the areas of computational neuroscience, robotics and brain–computer interfacing. Prof. Rao's group was the first to demonstrate direct brain control of a humanoid robot by humans in 2007 and direct brain-to-brain communication between humans in 2013. With Prof. Adrienne Fairhall, he offered the first MOOC (massively open online course) in computational neuroscience on Coursera. Prof. Rao’s other interests include classical Indian art, especially Indian miniature painting, and the 4000-year-old undeciphered Indus script, a topic on which he has given a TED talk.
Consciousness, Cognition and Culture

Nithin Nagaraj is currently an Assistant Professor, Consciousness Studies Programme, at the National Institute of Advanced Studies (NIAS), Bengaluru. Prior to this, he was a lead scientist at the Biomedical Signal Analysis Lab, GE Global Research Bengaluru (Sep. 2013–Sep. 2015). His PhD (NIAS, 2010) is in the area of Chaos Theory and its applications to Information Theory and Coding. His current research interests include understanding the reality of Conscious Experience and Information Flow in Neurons. He has co-authored 11 peer reviewed International Journal publications with over 500 citations, more than 30 National and International conference presentations. He is also a co-inventor of seven US patents (two issued).

Dr. Narayanan Srinivasan is currently Professor and Head at the Centre of Behavioural and Cognitive Sciences (CBCS), University of Allahabad, India. Dr. Srinivasan was a visiting scientist at the Riken Brain Science Institute from 2006 to 2012. He has a Master degree in Electrical Engineering from Indian Institute of Science and PhD in Psychology from University of Georgia, USA. He worked as a postdoctoral fellow at the University of Louisville (1996–1998), USA. He also worked at the Nanyang Technological University in Singapore for two years before joining one of the first centres for Cognitive Science in India.

Miguel Nicolelis, M.D., Ph.D., is the Duke School of Medicine Distinguished Professor of Neuroscience at Duke University, Professor of Neurobiology, Biomedical Engineering and Psychology and Neuroscience, and founder of Duke’s Centre for Neuroengineering. He is the Founder and Scientific Director of the Edmond and Lily Safra International Institute for Neuroscience of Natal. Dr. Nicolelis is also the founder of the Walk Again Project, an international consortium of scientists and engineers, dedicated to the development of an exoskeleton device to assist severely paralysed patients in regaining full body mobility.

Dr. Nicolelis has dedicated his career to investigate how the brains of freely behaving animals encode sensory and motor information. As a result of his studies, Dr. Nicolelis was the first scientist to propose and demonstrate that animals and human subjects can utilize their electrical brain activity to directly control neuroprosthetic devices via brain-machine interfaces (BMI). Over the past 25 years, Dr. Nicolelis pioneered and perfected the development of a new neurophysiological method, known today as chronic, multi-site, multi-electrode recordings. Using this approach in a variety of animal species as well as in intra-operative procedures in human patients, Dr. Nicolelis launched a new field of investigation, which aims at measuring the concurrent activity and interactions of large populations of single neurons throughout the brain. Through his work, Dr. Nicolelis has discovered a series of key physiological principles that govern the operation of mammalian brain circuits.

Dr. Nicolelis pioneering BMI studies have become extremely influential since they offer new potential therapies for patients suffering from severe levels of paralysis, Parkinson’s disease and epilepsy. Today, numerous neuroscience laboratories in the US, Europe, Asia and Latin America have incorporated Dr. Nicolelis’ experimental paradigm to study a variety of mammalian neuronal systems. His research has influenced basic and applied research in computer science, robotics and biomedical engineering. Dr. Nicolelis is a member of the French and Brazilian Academies of Science and has authored over
200 manuscripts, edited numerous books and special journal publications and holds three US patents. He is the author of Beyond Boundaries: The New Neuroscience of Connecting Brains with Machines and How It Will Change Our Lives; and co-authored The Relativistic Brain: How it Works and Why it Cannot be Simulated by a Turing Machine.

Georg Northoff is MD and a psychiatrist and holds two PhD degrees (Neuroscience/Psychiatry and Philosophy). He is the Canada Research Chair for Mind, Brain Imaging and Neuroethics as well as the Michael Smith Chair for Neuroscience and Mental Health at University of Ottawa Institute of Mental Health Research. His research focuses on the neural and biochemical mechanisms related to higher-order mental functions like consciousness and self in both healthy subjects and psychiatric disorders like depression and schizophrenia.

Neuroscientifically, he discovered the cortical midline structures and their association with the sense of self, while psychiatrically he is one of the world-wide leading experts on depression and catatonia. Methodologically, he pioneered the combined use of multiple imaging techniques, e.g., multimodal imaging, by combining fMRI with MEG, PET, EEG and MRS. Finally, he is one of the leading figures in linking philosophy and neuroscience in a non-reductive way, for instance the mind-brain problem and the debate about consciousness. He is the author of over 243 papers, numerous awards and several academic and non-academic books with two volumes on “Unlocking the brain. Vol. I: Coding, Vol. II Consciousness” (Oxford University Press) and "Minding the Brain, A Guide to Philosophy and Neuroscience" (Palgrave Macmillan) being the most recent ones. For further details, visit www.georgnorthoff.com

John P. John, M.D. is a Professor of Psychiatry and Head of the Department of Clinical Neurosciences at the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru. He heads the Multimodal Brain Image Analysis Laboratory (MBIAL) at NIMHANS. He is also an Adjunct Faculty at the National Institute of Advanced Studies (NIAS). Dr. John underwent post-graduate training in Psychiatry (M.D.) at NIMHANS.

He underwent Post-doctoral fellowship in analysis of magnetic resonance images (MRI) of the brain at the Washington University School of Medicine, St Louis, Missouri, USA. His research interest is in linking multi-modal brain imaging techniques (structural MRI, functional MRI, magnetic resonance spectroscopy, diffusion tensor imaging, electroencephalogram, event-related potential and polysomnomgram) with neurochemical and molecular genetic approaches in understanding the neurobiology of schizophrenia, dementia as well as of different cognitive states. Dr. John has published his research findings in various international and national journals of repute and has won national and international recognition for his work. Some of the awards that he has received include Prof Raguram Distinguished Young Teacher Award, 2014; Young Psychiatrist Award in the Asian Region, by the Royal Perth Hospital, Western Australia, 2008; Young Investigator Award for the best paper at the International Congress of Biological Psychiatry, 2007; Tilak Venkoba Rao Oration Award of the Indian Psychiatric Society, 2007; Fogarty International Research Training in Clinical Sciences Fellowship Award, 2003; and Marfatia Award of Indian Psychiatric Society for the best research paper, 2002.
Prathibha Karanth, a Speech Language Pathologist by training, has worked in premier national institutions such as NIMHANS, Bengaluru, the Central Institute of Indian Languages and the All India Institute of Speech & Hearing, Mysuru. Her primary focus has been on neurogenic communication disorders in children and adults. Prof Karanth is the recipient of several grants and awards from organizations such as the Common Wealth, UNICEF, Fulbright and Rockefeller Foundations as well as ICSSR, ICMR, NCERT National Academy of Medical Sciences and the Sir Ratan Tata Trust.

She has been elected President of the Indian Speech & Hearing Association, twice. She has published over fifteen books and manuals on language and communication disorders, assessment and training as well as over 80 papers in peer reviewed journals and book chapters (available on academia.edu). She also serves on the editorial boards of several journals. She is currently Series Editor for CommunicAids — an indigenous resource provider for children with communication disorders. Prof Karanth is currently Program Director and Managing Trustee of the Com DEALL Trust, which was set up by her in 2003 at Bengaluru for running the Communication DEALL program for children with Autism Spectrum Disorders designed by her. The program now runs out of 20 centres in India and will be scaled up further both in India and abroad. She also serves as Professor Emeritus at the SR Chandrasekhar Institute of Speech & Hearing and Adjunct Faculty at NIAS, Bengaluru.

Naren P Rao, born in 1981, earned his MBBS (2004) from Sri Devaraj Urs Medical College, Karnataka and MD in Psychiatry (2008) from National Institute of Mental Health and Neurosciences, Bengaluru. Later he worked as a senior resident at NIMHANS (2008–2011) and as a postdoctoral fellow at Research Imaging Centre, Centre for Addiction and Mental Health, University of Toronto, Canada (2011–2013). He was a faculty at Centre for Neuroscience, Indian institute of science from 2013 to 2015. Currently, he is working as Associate Professor of Psychiatry at National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru.

He has authored 75 peer reviewed publications and six book chapters. He is recipient of awards from Society of Biological Psychiatry, Brain and Behaviour research foundation, USA and Canadian institutes of Health Research. His research interest includes understanding the neurobiology of Schizophrenia using multimodal neuroimaging methods — structural and functional magnetic resonance imaging and positron emission tomography.

Owen Flanagan is James B. Duke Distinguished University Professor at Duke University, Durham, NC, USA. He works on philosophy of mind, moral psychology and cross cultural philosophy. He is author of Varieties of Moral Personality: Ethics and Psychological Realism (Harvard 1991), Consciousness Reconsidered (MIT 1992). His latest work is on cross-cultural moral psychology and ethics: The Geography of Morals: Varieties of Moral Possibility, which will be published by Oxford in 2016.
Stephen G. Post is a public speaker on topics including the health benefits of helping others, the spirit of philanthropy and compassion in healthcare. He is a best-selling author, who has taught at the University of Chicago Medical School, Case Western Reserve University School of Medicine (1988–2008) and Stony Brook University School of Medicine (2008–present), where he is the Founding Director of the Centre for Medical Humanities, Compassionate Care and Bioethics (designated as a special strength of the Stony Brook School of Medicine by the LCME visiting committee 2011).

He is an elected member of the College of Physicians of Philadelphia, the New York Academy of Medicine and the Royal Society of Medicine, London. Post addressed the U.S. Congress on volunteerism and public health and received the Congressional Certificate of Special Recognition for Outstanding Achievement. He was selected as the Public Member of the United States Medical Licensing Examination (USMLE) Composite Committee (2000–2005), being reappointed on the basis of ‘greatly appreciated contributions.’ In 2012, post received the Pioneer Medal for Outstanding Leadership in Health Care from the Health Care Chaplaincy Network. He received the Kama Book Award in Medical Humanities from World Literacy Canada in 2008 and the “top notch” public speaking award from the Ohio Endowment for the Humanities. Post has served several positions — a Trustee of the John Templeton Foundation (2008–2014), a Senior Scholar for the Positive Psychology Centre at the University of Pennsylvania and a Senior Faculty Scholar in the Centre for Spirituality, Theology and Health at the Duke University Medical Centre (see www.StephenGPost.com).

Post’s best-selling book The Hidden Gifts of Helping (2011) followed his 2007 blockbuster (with Jill Neimark) Why Good Things Happen to Good People: How to Live a Longer, Healthier, Happier Life by the Simple Act of Giving (Broadway Book- Random House). His writings were included in Best American Spiritual Writing in 2005. He has written eight scholarly books on generosity and compassionate care, and is the editor of nine others, including Altruism & Health: Perspectives from Empirical Research, and Altruism and Altruistic Love: Science, Philosophy and Religion in Dialogue, both published by Oxford University Press. In 2001, he founded the Institute for Research on Unlimited Love in 2001, named by Sir John Templeton, who personally selected Post as President (www.unlimitedloveinstitute.com). The Institute is a free-standing non-profit 501(c) 3 that researches and distributes knowledge on selfless love. Post's book The Moral Challenge of Alzheimer's Disease: Ethical Issues from Diagnosis to Dying (Johns Hopkins University Press, 2000, 2nd edition) was designated a “medical classic of the century” by the British Medical Journal (2009), which wrote, “Until this pioneering work was published in 1995, the ethical aspects of the one of the most important illnesses of our aging populations were a neglected topic.” Post is an elected Member of the Medical and Scientific Advisory Board of Alzheimer’s Disease International, and one of several recipients of the Alzheimer’s Association distinguished service award “in recognition of personal and professional outreach to the Alzheimer’s Association Chapters on ethics issues important to people with Alzheimer’s and their families” (1998).

Actively engaged in research on the health benefits of compassionate care and of giving and 12-Step Programs, Post is the primary author of over 200 articles in peer-reviewed journals including Science, Annals of Internal Medicine, American Journal of Addictions, Journal of the American Academy of Religion, Social Philosophy, American Journal of Psychiatry, First Things, Dementia, Journal of the American Medical Association and Lancet. An elected Fellow of the Hastings Centre and a Senior Scholar of the Kennedy Institute of Ethics at Georgetown University, Post served as Editor-in-Chief of the five-volume Encyclopaedia of Bioethics (Macmillan Reference/Gale, 2004), which was awarded “Best Reference Work” by the American Library Association.
Victoria Lysenko, D.Sc., Head of the Department of Oriental Philosophies, Institute of Philosophy, Russian Academy of Science (Moscow), is a Russian philosopher and Indologist, specialised in Indian classical philosophy and religion. She is Professor at the Russian State University for Humanities (Moscow). She studied Sanskrit with the eminent Russian scholar Professor Tatiana Elizarenkova. Graduated from the Department of Philosophy of Moscow State University in 1976, she defended her PhD thesis “The Vaisheshika Atomism” in 1982. In 1986, she published her first book Philosophy of Nature in India. Atomism of the Vaiśeika School. (Moscow: ”Nauka Publishers”, 1986).

V. Lysenko worked as a research fellow at the Institute of Scientific Information on Social Sciences, USSR Academy of Sciences (1980–1984) and as an editor at the Publishing House “Soviet Encyclopaedia” (1984–1990). From 1990, she is engaged in research work at the Institute of Philosophy as a senior fellow, a research professor and now the head of the department. For almost 20 years, she studied the Vaiśesika tradition of Indian philosophy, especially its atomistic theory and its system of categories. In her D.Sc. thesis — Continuity and Discontinuity in Indian Thought: Vaiśesika and Grammatical Philosophy (Moscow 1998) — she tried to show that the Vaiśesika system of categories have developed from the grammatical categories. She published her translations of the Vaiśesika texts from Sanskrit into Russian and her research of these texts in two books: Universum of Vaiśesika (Moscow: Vostochnaya Literatura, 2003) and Padārthadharmasangraha” of Prashastapāda with Nyāyakandalī of Srīdhara (Moscow: Vostochnaya Literatura, 2005).

Her other research areas include Buddhist philosophy and epistemology of perception in Indian philosophy in general. She published a number of books thereon containing her translations of Buddhist and Brahmanic Sanskrit texts (Nyāya, Advaita, Mīmāṃsa): Early Buddhist Philosophy, (Moscow: Vostochnaya Literatura, 1994); Immediate and Mediated Perception: Controversy between Buddhist and Brahmanic Philosophers (analysing the texts) (Moscow: Institute of Philosophy, 2011); Sāntarakṣita and Kamalaśīla on the instruments of valid cognition (with Natalya Kanaeva, Moscow: Institute of Philosophy, 2014). She believes that Indian classical theories of perception should be analysed in a comparative perspective, taking into account the achievements of contemporary cognitive sciences. She published around 300 papers (some of them in English and French) in different Russian, Western and Indian peer-reviewed journals including Voprosy filosofii (Questions of Philosophy), Journal Asiatique. Asiatische Studien/ Études Asiatiques, Philosophy East and West, Journal of Indian Philosophy, journal of Indian Council of Philosophical Research. With her husband, Michel Hulin, she has published a book in India: Victoria Lysenko, Michel Hulin: Classical Indian Philosophy Reinterpreted, Decent Books, New Delhi, 2007. She is also the author and moderator of the project “Russian Indologists about India” supported by the Indian Embassy in Russia. As a visiting professor, she was invited to India UGC (Delhi, Benares and Pune) in 2005; Jadavpur University, Kolkata in 2006); to France: Ecole Pratique des Hautes Etudes, Paris in 2008 and 2011; and to Lithuania: Vilnius in 2011
Michel Bitbol is *Directeur de Recherche* at the CNRS, in Paris, France. He is presently based at the *Archives Husserl*, a centre of research in Phenomenology. He received successively his M.D., his Ph.D. in physics, and his “Habilitation” in philosophy in Paris. He worked as a research scientist in biophysics from 1978 to 1990. From 1990 onwards, he turned to the philosophy of physics. He edited texts by Erwin Schrödinger and developed a Neo-Kantian philosophy of quantum mechanics. In 1997, he received an award from the *Academie des sciences morales et politiques* for his work in the philosophy of quantum mechanics.

Later on, he studied the relations between the philosophy of physics and the philosophy of mind, working in close collaboration with Francisco Varela. He then learnt some Sanskrit and published a book (*De l’intérieur du monde*, 2010) in which he draws a parallel between Buddhist dependent arising and non-supervenient relations in quantum physics and the theory of knowledge. He recently developed a conception of consciousness inspired from an epistemology of first-person knowledge, together with a phenomenological critique of naturalist theories of consciousness (*La conscience a-t-elle une origine?* 2014).

Shatavadhani R. Ganesh is a practitioner of the art of avadhana, a polyglot, an author in Sanskrit and Kannada and an extempore poet in multiple languages. He has performed more than 1000 avadhanas, in Kannada, Sanskrit, Telugu and Prakrit. He is known for extempore composition of poetry (āśukavita) during these performances and even of chitrakavya. He is the only Satāvadhāni from Karnataka. He once set a record by composing poetry for 24 h continuously. From 30th November 2012 to 2nd December 2012, he performed the first ever Shatavadhana entirely in Kannada. On 16th February 2014, in Bengaluru, he performed his 1000th avadhāna.

Ganesh was born on 4th December 1962, in Kolar, Karnataka, to R. Shankar Narayan Aiyar and K. V. Alamelamma. Ganesh picked up Tamil, Kannada and Telugu from his environment as a child. In his childhood, he also read Sanskrit and Kannada literature and started writing poetry at the age of sixteen. He learned English at school and later learned several other languages like Prakrit, Pali, Tamil, Hindi, Marathi, Greek, Latin and Italian. He has a B.E. degree in mechanical engineering from UVCE, an MSc (Engineering) degree in metallurgy from IISc. He pursued research in materials science and metallurgy. Moreover, he has an MA degree in Sanskrit and a D. Litt in Kannada, which was awarded by Hampi University for his thesis on the art of Avadhana in Kannada. Ganesh is well known for his performances of avadhana, in which he composes extempore solutions in metrical verse to problems posed in parallel by the prchakas (questioner) on stage, satisfying the constraints imposed by them, while simultaneously dealing with interruptions designed to break his concentration. The performance tests poetic skill, creativity, memory, concentration, scholarship and wit. The main variants are the *Astāvadhāna* (eight pr cchakas) and *Śatāvadhāna* (hundred pr cchakas) — he performs both. He performed his first Shatavadhana at Bharatiya Vidyabhavan, Bengaluru on 15th December 1991. He gave another performance 15 days later, then one each in 1992 and 1993, with his fifth, the first to be done entirely in Kannada, in 2012. He has so far written three books on his Shatavadhanas, Shatavadhana Sharade, Shatavadhana Srividye and “Sataavadhaana shaashvati” to groom future avadhanis, besides his D. Lit thesis *The Art of Avadhana* in Kannada and the forthcoming *Avadhana Sahasra*. He has also begun lectures on poetry.
composition, prosody and poetics on the website of the "Padyapaana" organisation. He performed a shatavadhana in a single day in 1991. He also gives public lectures on dance (nāṭya śāstra), music, art, culture, literature, poetics, etc. In his kAvya-chitra shows, he performs with painter B. K. S. Varma, composing poems while the latter paints. He has also written lyrics and composed verses for dance performances. He learned the performance art Yakshagana and conceived the idea of eka vyakthi yakshagana (single-person Yakshagana), of which several performances have been given by Mantapa Prabhakara Upadhyaya. He has played the role of Horatio (dubbed Harshananda) in a Sanskrit production of Hamlet.

Bindu M. Kutty is currently working as Professor at the Department of Neurophysiology, NIMHANS, Bengaluru. She has over twenty years of experience in teaching and research in the area of Neurophysiology. Her research areas of interest include understanding the neural basis of consciousness across the illness to wellness spectrum. She and her research team have contributed towards the understanding of neural correlates of meditation (Vipassana meditation and Rajayoga meditation) and neurobiology of mental disorders (Schizophrenia and Generalised Anxiety Disorders) as a means to elucidate the neural mechanisms of consciousness and cognitive properties under different mental states.

The team has contributed immensely in delineating the role of Vipassana meditation proficiency on sleep organization — how meditation proficiency enhances sleep architecture; how meditation practices, such as Vipassana and Rajayoga, enhance cognitive information processing, improve well-being; and the neural correlates of such behavioural states as a means to understand how meditation practices help to modulate the brain network properties. On the other hand, studies on the neurobiology of schizophrenia, made them to realize the defective thalamo cortical mechanisms associated with wake and sleep states and how such understanding would help elucidating the schizophrenia pathophysiology. Currently, the group is looking into sleep abnormalities associated with motor neuron disorders, such as cerebellar ataxia and Parkinson's disease, as a means to understand the pathophysiology associated with these disorders. In addition to human research studies, her research group has extensively studied the brain mechanisms of cognitive impairment using appropriate animal models of Alzheimer's disease, Schizophrenia etc. Additionally, her group has contributed significantly to the importance of strategies, such as enriched environment, transplantation, etc., towards establishing functional recovery following CNS insults in rodent models. These studies provide much insight into adult brain plasticity and cognitive reserve capacity of the brain.

Dr. Bindu collaborates with several scientists: Prof. Ravindra Panth, Director, Navanalanda Mahavihara; Prof. Sunao Uchida, Waseda University, Japan; Prof. Sangeetha Menon and Dr. Binoy from NIAS, Bengaluru; Dr. M.M. Panicker, Neurobiology Division, NCBS, Bengaluru; Prof. John P. John (Psychiatry), Prof. Seema Mehrotra, (Positive Psychology division of Clinical Psychology), Dr. Laxmi T. Rao and Prof. Sathyaprabha (Neurophysiology), Prof. Pramod Pal and Dr. Ravi Yadav (Neurology) — her colleagues from NIMHANS.
Jamuna Rajeswaran obtained her M.Phil. and Ph.D. in Clinical Psychology from NIMHANS. Her specialization is in the area of Clinical Neuropsychology. She joined as faculty at the Department of Clinical Psychology, National Institute of Mental Health and Neurosciences (NIMHANS) and currently working as Additional Professor and Head of Clinical Neuropsychology and Cognitive Neuroscience Unit, NIMHANS. She has also been invited to be adjunct faculty of NIAS, IISc. She has pioneered the Holistic Neuropsychological Rehabilitation work in India.

She is the first person to introduce the EEG Neuro-feedback training in India for various Clinical conditions, after obtaining training in Neuro-feedback Therapy from the Brain Masters, Cleveland, Ohio, USA. She has guided several M.Phil. and Ph.D. Clinical Psychology, Neuroscience, M.Ch Neurosurgery, and M.D Psychiatry, Neuroanaesthesia and Clinical Neuroscience theses. She is the recipient of the UGC Visiting faculty fellowship to Mauritius. She has presented papers in several National and International conferences and published articles in National and International journals. She has edited a book published by Elsevier on “Neuropsychological Rehabilitation — Principles and Application” and written chapters in books. She is a member of the editorial board for IACP, IJCP, IJLST (International Journal of Life Sciences and Technology) and associate journals. She is also member of several professional societies, to name a few, Member of the International Neuropsychology society, Life member of India Society for Clinical and Experimental Hypnosis (Affiliated to International body of Clinical and Experimental Hypnosis, Australia), Fellow and Life member of Behavioural Medicine Society of India, Professional Life member of Indian Association of Clinical Psychologist, Professional Life member of Karnataka State Clinical Psychologist Association, Life member of NIMHANS Alumni Association, Associate member of Neurological Society of India, Associate member National Magnetic Resonance Society and Associate Life member of IAN. Sri Lanka Association of Psychology conferred “MANO VIDYADHIPATHI SAMMANA”, eminent in Psychological Science, in recognition and appreciation of her invaluable contributions with utmost commitment for the benefit of humanity in 2011.

Frank Krueger is currently Associate Professor of Social Cognitive Neuroscience at the Molecular Neuroscience Department/Department of Psychology at George Mason University (GMU), Fairfax, VA, USA. He is also a guest Professor of Clinical and Biological Psychology at the Department of Psychology at the University of Mannheim, Germany. Dr. Krueger is the Chief of the Social Cognition and Interaction: Functional Imaging (SCI:FI) Laboratory and Co-Director of the Centre for the Study of Neuroeconomics (CSN) at the Krasnow Institute for Advanced Study at GMU.

Moreover, he is a Faculty Associate at the Centre for Excellence in Neuroergonomics, Technology and Cognition (CENTEC) at GMU, a Faculty Associate at the Laureate Institute for Brain Research in Tulsa, OK, USA and an Adjunct Faculty (Consciousness Studies Programme) at the National Institute of Advanced Studies (NIAS), Indian Institute of Science Campus, Bengaluru, India. Dr. Krueger received his Master's degree in Psychology, a Ph.D. degree in Cognitive Psychology and a Habilitation degree (venia legendi) in Psychology at the Department of Cognitive Psychology, Humboldt University, Berlin. He also earned a Master’s degree in Physics from Free University Berlin in Germany. He worked as a post-doctoral fellow in Dr. Grafman’s Cognitive Neuroscience Section at the National Institute of Neurological Disorders and Stroke, National Institute of Mental Health, Bethesda, MD, USA.
As a cognitive psychologist and neuroscientist, Dr. Krueger is interested in understanding the mind-brain relationships of human social cognition, focusing on the importance of cognitive and affective processes in mediating social interactions. By applying paradigms from cognitive psychology, experimental economics, and social neuroscience, he is pursuing two different lines of research to study the proximate neural mechanisms (i.e. how they work) and ultimate functions (i.e. why they exist and work) of social cognition. The first one aims to understand the biological basis of how beliefs shape cooperative and competitive behaviours in social and economic contexts, while the second is designed to shed light on the neuroplasticity of social cognition in healthy development and recovery from brain injury. Dr. Krueger is using an interdisciplinary multi-methods approach that combines neuroimaging (brain structure, function and connectivity), neuroendocrinology and neurogenetics to promote new perspectives in understanding the neural architecture of social cognition. Such an approach can help to transfer basic research findings into treatment for and prevention of social brain disorders ultimately providing benefits to human health.

Dr. Krueger has authored/ co-authored about one hundred publications including research papers, book chapters and books. He has presented summaries of his research findings at numerous national and international conferences. His research, funded by several respectable agencies, has been covered both in international newspapers and on national television. Dr. Krueger is frequent ad-hoc reviewer for about thirty journals in the field of social and cognitive neuroscience and serves at editorial boards of several neuroscience journals and national and international grant review panels.

Ralph Abraham earned his Ph.D. in Mathematics at the University of Michigan in 1960 and later he taught at Berkeley, Columbia and Princeton before moving to Santa Cruz. He has held visiting positions in Amsterdam, Paris, Warwick, Barcelona, Basel, Florence, Kolkata and Kyoto, and is the author of more than 20 texts, including eight books currently in print. He has been active on the research frontier of dynamics — in mathematics since 1960 and in applications and experiments since 1973. He has been a consultant on chaos theory and its applications in numerous fields (medical physiology, ecology, mathematical economics and psychotherapy, etc.). He is an active editor for the technical journals World Futures and the International Journal of Bifurcations and Chaos.

In 1975, he founded the Visual Mathematics Project at the University of California at Santa Cruz, which became the Visual Math Institute in 1990, with its popular World Wide Web site since early 1994. He has performed works on visual and aural mathematics and music (with Ami Radunskaya and Peter Broadwell) since 1992.
He was born in December 1947 in Amsterdam. He received Master of mathematics at Utrecht University 1968 and PhD in mathematical logic at Utrecht University 1971, under supervision of G. Kreisel and D. van Dalen. He later pursued postdoctoral research at Stanford University (1971–1972), collaborating with E. Hilgard on hypnosis, notably on unmasking faking subjects. He has been practising Zen meditation (1972–1979) and insight meditation since 1979. He was Assistant/associate Professor of mathematical logic at Utrecht University (1972–1986) and Full Professor of Foundations of mathematics and computer science at Radboud University, Nijmegen, The Netherlands (1986–2015).

Since then he is an emeritus professor. He has been teaching vipassana meditation since 2001. He has been directing the Mind-Brain-Mindfulness research group, investigating the effects of meditation. He is interested, especially in understanding mechanisms of consciousness and mindfulness. For details, see: https://dhammapages.wordpress.com/. He has received the following awards: Member of Academia Europaea (since 1992); Member of Hollandsche Maatschappij der wetenschappen (since 1995); Member of Royal Dutch Academy of Science (since 1997); Recipient of the Spinoza Award (2002); Lorentz distinguished fellow (2012–2013). He has also authored the following books: The lambda calculus, its syntax and semantics (1981/1984), Lambda calculus with types (2013), with W. Dekkers and R. Statman. For his ‘Logic’ papers, visit https://barendregtlogicpapers.wordpress.com/logic-publications/.

Partha Ghose is currently Honorary Scientist, National Academy of Sciences, India. He was formerly a Professor at the S. N. Bose National Centre for Basic Sciences, Kolkata and a Senior Scientist Platinum Jubilee Fellow of NASI. He initially worked on theoretical High Energy Physics, but now specialises in the foundations of quantum mechanics. His paper1 with D. Home and G. S. Agarwal on the nature of wave-particle duality has been widely quoted and tested experimentally in Japan2 and Italy3. His work on Bohmian trajectories of photons4 formed the basis for a comparison of these trajectories from those that were later observed experimentally with weak measurements5.

His papers on entanglement in classical optics Bell violations6,7 have also been widely noted. He has also published papers and books on the philosophy of science. He received the National Award for the Best Science and Technology coverage in the Media of the National Council for Science and Technology Communication (NCSTC) for the period 1986–1990 and was awarded the Indira Gandhi Prize for popularizing science by the Indian National Science Academy.

Some of his publications and associated papers:


Books:


Giuseppe Vitiello is a Full Professor (Professore Ordinario) of Theoretical Physics, Dipartimento di Fisica "E.R.Caianiello", Universita’ di Salerno - 84084 Fisciano (Salerno), Italy; Associate researcher, INFN (Istituto Nazionale di Fisica Nucleare); Ph.D. in Physics, University of Wisconsin, Milwaukee, USA, 1974 (Supervisor Prof. Hiroomi Umezawa); Laurea in Fisica, Universita’ di Napoli, Italy, 1970 (Supervisor Prof. Francesco Guerra). His research activity includes spontaneously broken symmetry in gauge theory of elementary particles, condensed matter physics and the physics of biological systems and brain studies.


He was the scientific coordinator of the Salerno Quantum Field Theory Unit of the European Science Foundation Networks (central coordinator Prof. T. W. B. Kibble, Imperial College, London), 1995–1997 and 1997–2006; of the Salerno Quantum Field Theory Unit of the MURST/Miur research projects (PRIN) since 1996; of the Salerno Unit of the INFN national Project FI42 on Algebraic methods in QFT. He serves as referee for several journals (Physical Review Letters, Physical Review,
Biographies of Invited Speakers

Physica Scripta, etc.). He is also member of several Scientific Advisory Boards and Organising Committee of International Conferences and Workshops.

V N Jha retired as Professor and Director, Centre of Advanced Study in Sanskrit, University of Pune, Maharashtra, India. He received his education and training from eminent scholars of Bengal, Varanasi and Pune. He received training in both Indian traditional systems of education as well as Western education. He also received special training in Indian Logic (Nyaya), Grammar (Vyakarana) and Indian Hermeneutics (Purvamimamsa) from great teachers like Pandit Sitakanta Acharya (Bengal), Pandit Sivarama Krishna Sastri of Annamali University and Pandit Srinivasa Sastri of Annamalai University.

He taught various branches of Sanskrit learning in Pune University, Jawaharlal Nehru University (New Delhi), University of Berlin (Germany), Nagoya University (Japan), University of Lausanne (Switzerland) and Mahatma Gandhi Institute, Moka (Mauritius). He has contributed to research in Veda, Vyakarana, Nyaya, Mimamsa, Philosophy of Language, Indian Psychology and Aesthetics. Prof. Jha has authored and edited over 50 books and over 200 articles on those areas of specialization. Prof. Jha has developed inter-disciplinary courses such as M.A. in Indian Logic and Epistemology, M.A. in Indian Linguistics in the University of Pune. He has launched a research Journal called "Journal of Indian Intellectual Traditions". Currently, Prof. Jha is actively engaged in promoting studies in Indian Intellectual, Philosophical and Spiritual Culture.
Anindya “Rana” Sinha is currently Professor at the National Institute of Advanced Studies (NIAS) in Bengaluru, Senior Scientist at the Nature Conservation Foundation in Mysuru, Adjunct Faculty at the Centre for Neuroscience of the Indian Institute of Science (IISc) in Bengaluru, all in India, and Honorary Research Fellow at the College of Humanities of the University of Exeter in Exeter, UK. He had earlier studied botany, with specialisation in cytogenetics at the Calcutta University in Kolkata, India and earned a doctorate in molecular biology in 1993 from the Tata Institute of Fundamental Research (TIFR) in Mumbai, India, having worked on the biochemical genetics and molecular biology of carbohydrate metabolism in baker’s yeast.

Sinha’s early research concerned the behavioural biology of wasps, social cognition in macaques, classical genetics of human disease and the philosophy of human-nonhuman species relationships, which he studied at the Centre for Ecological Sciences of the Indian Institute of Science and the National Centre for Biological Sciences, both in Bengaluru, India. His current research interests, which he has been involved in over more than the last two decades, have, however, primarily been in the areas of animal behavioural ecology, cognitive ethology, evolutionary biology, population and behavioural genetics, urban animal studies and conservation biology, particularly of primates and elephants but of other animal taxa as well. More specifically, Sinha’s academic contributions, in recent years, have primarily been in the understanding of cognitive mechanisms underlying complex social behaviours — acquisition and self-referential use of social knowledge, tactical deception and referential gestural communication — in wild bonnet macaques; resource utilisation, niche partitioning and conservation biology of primate communities in the lowland rainforests of north-eastern India; and the influence of individual histories, enclosure properties and visitor presence on abnormal stereotypic behaviour and reproductive performance of captive lion-tailed macaques across Indian zoos. Sinha was responsible for the discovery of a new macaque species, the Arunachal macaque, in 2005, in the Eastern Himalayas and has subsequently researched collaboratively on the evolutionary history and population genetics of this species across its distribution range in the western and central Arunachal Pradesh state in the north-eastern India. He also leads a research team that has been investigating the population structure and demographic history of a population of wild bonnet macaques, subject to strong anthropogenic influences, in the Bandipur and Mudumalai National Parks of southern India in the long term and documenting the life-history strategies of more than 1,500 individually identified animals in this population over 15 years now. More recently, Sinha has begun to explore the urbanisation of macaque populations and the influence of human perceptions, attitudes, and behaviour on this process across urban, rural and forest landscapes of the country. Finally, Sinha is deeply interested in the philosophy of biology, particularly of genetics, ecology and conservation, biology education and the popularisation of science in the country. He has, thus, been instrumental in establishing a Master’s degree course in wildlife biology and conservation in Bengaluru, India, works closely with the International Biology Olympiad, and has lectured extensively in a variety of educational institutions, including junior and senior schools, colleges and universities, and in research institutes, both across and outside India.
Biographies of the Faculty Members

Gagan Deep Kaur is currently a Postdoctoral Associate of the Consciousness Studies Programme, at National Institute of Advanced Studies (NIAS), Bengaluru. Her postdoctoral work is on the topic *Cognitive Dimensions of Talim System in Kashmiri Carpet Designing*; the field site is Srinagar, Kashmir. Her postdoc mentors are Sangeetha Menon and V V Binoy at NIAS. She was a temporary Research Assistant from 2007–2009. Her research experience is in Philosophy of Cognitive Science, and her interests include Phenomenology and Social Cognition.

She won the University Gold Medal for earning the first place in Masters in Philosophy, Punjab University, Chandigarh, in 2006. She obtained her Ph.D. in Philosophy of Cognitive Science, supervised by Prof. Milind Malshe, from Department of Humanities & Social Sciences, Indian Institute of Technology Bombay, Mumbai, India for the following thesis topic: *Eye of the Silicon Mind: Assessing Computational Imagination*.

Sisir Roy is T.V. Raman Pai Chair Visiting Professor, National Institute of Advanced Studies, IISC Campus, Bengaluru since November 2014. He was Professor at Physics and Applied Mathematics Unit, Indian Statistical Institute, Kolkata during 1980–2014. He worked as distinguished visiting professor in George Mason University, USA since 1999–2007 and worked as visiting professor in many universities in USA and Europe. He published more than 150 research papers in peer reviewed international journals and 12 research monographs/edited books with Kluwer Academic, World Scientific and other publishers.

His monographs include “Demystifying the Akasha — Quantum Vacuum and Consciousness” jointly with Ralph Abraham. Currently, he is working as a member of editorial boards in various international journals. His research interests include “Foundations of Quantum Theory”, “Brain Function Modelling and Consciousness”, “Quantum Ontology and Modelling in Cognitive science” and “Theoretical Astrophysics and Cosmology”. At international level, he has collaborated primarily with Prof. J.P. Vigier (France), Prof. Bo Lehnert (Sweden), Prof. Menas Kafatos (George Mason University, USA), Prof. Ralph Abraham (University of California) and Prof. Rodolfo Llinas (New York University School of Medicine, NY, USA).

Dr. Sreekantan is currently Visiting Professor at the National Institute of Advanced Studies, Bengaluru, and also Chairman, Gandhi Centre of Science and Human Values of the Bharatiya Vidya Bhavan, Bengaluru. He was Dr. Radhakrishnan Visiting Professor in 1992. He was the Director of the Tata Institute of Fundamental Research during 1975–1987 and the Indian National Science Academy Srinivasa Ramanujan Professor during 1987–1992. He has specialised in cosmic rays, high-energy physics and high-energyastronomies and has published over 200 research papers. He has received a number of professional awards including the RD Birla Award of the Indian Physics Association and the Padma Bhushan. He has held a number of visiting positions including in the US and Japan.

After moving to NIAS, Prof. Sreekantan shifted his interests from pure science to studies on scientific and philosophical studies on consciousness and exploration of commonalities and similarities in holistic approaches in modern science and ancient philosophies. Through two seminars organised by him at NIAS — the historical epistemological, mathematical, experimental and technological factors that laid the foundations of sciences and led to the growth of modern science over the last few decades —were analysed, and these have been incorporated in a volume that was published by ICPR.
Sangeetha Menon joined National Institute of Advanced Studies, in January 1996, in the Indian Institute of Science campus, Bengaluru, India. She is Professor and Head of the Consciousness Studies Programme. This was the first academic group that started in India to study consciousness with an interdisciplinary and a multidisciplinary mandate. Sangeetha is a philosopher with keen interest in consciousness. Her major area of research is in philosophy of psychology. Her expertise is in Indian philosophy, consciousness studies, philosophy of psychology, philosophy and psychology of self. She works with her colleagues at NIAS and collaborators across the world in creating and encouraging a first-person centred approach to understand consciousness and cognitive capabilities that favours experiential well-being for all.

Dr Menon’s professional qualifications include degrees in biology and philosophy. She is a first rank holder and gold medallist from Maharaja’s College for Women, Trivandrum for post-graduate degree in philosophy. The thesis for her doctoral degree, from University of Kerala, is on the concept of consciousness in the Bhagavad Gita which was completed with junior and senior research fellowship from University Grants Commission, India.

Sangeetha Menon started her research with a comparative study of consciousness, from the East and the West, with focus on the theories of agency, emotion, freedom, self and human well-being in the Bhagavad Gita. Subsequently, she focused on Indian philosophical concepts criss-crossing the works of philosophers, such as Sankaracharya, Abhinavagupta, Narayana Guru and others, and also bringing in Indian aesthetics and dramaturgy to understand cognitive dimensions of creative expressions and personal agency. Her initial papers argue for an epistemological shift that considers the ontological primacy of self, and the importance of the *experiencer* that would present the ‘harder problem’ of consciousness. While some of her initial studies were deeply metaphysical and philosophical in approach, she moved on to engaging philosophy with biology and psychology to understand the primary issue in consciousness, which is the ‘self’. She is one of the originators of the field of Indian psychology, guiding research in the area of well-being studies, life-sustaining values, self-transformation and artistic experience.

Dr Menon, is a Board Member of the International Association for Transpersonal Psychology (2009 to date), Council Member of the Indian Council of Philosophical Research (2012 to date), Taskforce Member of the national Cognitive Science Research Initiative of Department of Science and Technology, Govt. of India (2013 to current) and a Nominated Member, International Society for Science and Religion, St Edmund’s College, Cambridge (2009 to date).

One of her primary contributions in consciousness studies is in presenting and engaging with the concept and experience of self from the neurobiological and philosophical point of views, and theorising a ‘self-challenged brain and brain-challenged self’. She argues that to understand consciousness is to understand the self. Her recent books are: “Brain, Self and Consciousness: Explaining the conspiracy of experience” (Springer 2014) and “Interdisciplinary perspectives on Consciousness and the Self” (Edited volume, Springer, 2014). Apart from her academic interests, she writes poetry, fiction, and is an avid photographer, artist and web designer. She also spends her time for charity activities through Sambodh Foundation, India. For further details see http://consciousnessshop.com/sm-cv.html
Invited Speakers and Session Chairpersons

Anindya Sinha
Professor and Dean (Academic Affairs)
National Institute of Advanced Studies
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ABOUT THE SYMPOSIUM ON 12 DEC, 2015
A Dialogue based Symposium
“Reality According to Modern Physics and Classical Traditions”

12 December 2015
9.30 am to 1.30 pm

B V Sreekantan and Sisir Roy

Werner Heisenberg wrote:
"Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of the past centuries. At that time, these abstractions could be disregarded as mere mental exercises by those scientists whose only concern was with reality, but today we are compelled by the refinements of experimental art to consider them seriously."

What are those philosophical abstractions?

i. Origin of the Universe and Quantum Vacuum:

How did the universe originate? According to modern cosmology, the universe is originated from the fluctuations of quantum vacuum. Vacuum in modern physics is supposed to be devoid of any matter. Quantum vacuum is a vacuum where the principles of quantum theory are operative. Accordingly, fluctuations associated with the quantum nature of the vacuum prevail everywhere in the vacuum which gives rise to the birth of physical universe. This vacuum or ontologically speaking a substratum exists which is devoid of any matter but full of activities or full of potentialities. These potentialities give rise to various attributes of the physical universe.

Guiding Questions for the Dialogue: Is the emptiness of quantum vacuum similar to emptiness of Buddhist philosophy or Akasa in Vedanta? Is this fluctuation similar to Spanda in Kashmiri Shaivism?

ii. Identity and Individuality:

The impact of the quantum physics on our understanding of the identity and individuality of objects was noted almost immediately by physicists such as Bohr, Born and Heisenberg. Can the fundamental entities, like electron, proton, photon, be regarded as individual like rock, chair, table, etc.? There are two most metaphysical notions: notion of an object and notion of identity. This is related to counting or enumerating items — there it seems that one must at least be able to identify and differentiate them. The concept of counting for a collection of objects like gas molecules led Boltzmann to formulate a rule for counting, which was introduced in classical statistical mechanics known as Boltzmann statistics. The work of Bose, Einstein, Fermi and Dirac led to introduce quantum statistics based on different rule of counting. In classical statistical mechanics, a permutation of two otherwise indistinguishable objects was taken to give rise to a new arrangement — because although indistinguishable, the objects were still distinct individuals — however, the same is not true in quantum statistical mechanics. This was taken to imply that the objects had ‘lost’ their identity and they were, in some sense, non-individuals. If the quantum objects are not considered like classical objects, such as gas molecules, table, chair, book, etc., Leibniz’s famous principle of ‘the identity of indiscernible’ is in fact violated — it states that no two distinct things exactly resemble each other. Objects, properties and relations have been widely discussed in the realm of philosophy. Objects are conceived to be entities that are by their very nature property-bearers and entities that do or can stand in various relations to one another.

Guiding Question for Dialogue: What are the views on identity and individuality of the objects according to various traditions?

iii. Time, Causality and Consciousness:

Cause and effect relationship or the principle of causality plays an important role in modern physics. The ordering
Consciousness, Cognition and Culture

in time, like past, present and future, is closely related to cause and effect relationship. In our physical universe, there exists smallest duration of time and space called Planck time and Planck length below which concept of space, time and causality do not exist. At the level of Planck, space and time are discrete. One the other hand, at the level of elementary entities like electrons, protons etc., as well as in our everyday life space, time are continuous. One of the challenging issues in 21st century physics is how the continuum space time emerges from discrete structure or causality arises. There exists a smallest duration of time in our brain called quanta of time — this is related to understanding cognitive activities. Even the very notion of time poses a challenge within the present per view of neuroscience.

Guiding Question for the Dialogue: Various Indian schools of philosophy discussed about the smallest unit of time. The ontology of space-time, space-time as network of relations, cause and effect relationship have been studied by various Indian schools for many centuries. What are the views on the smallest unit of time, ontology of space time, causality and its origin?

iv. Quantum Entanglement and Metaphysics of Relations:

Entanglement is the unusual behaviour of elementary particles, like electron, proton, photon etc., where they become linked so that when something happens to one such elementary particle say electron, it also happens to the another electron — no matter how far apart they are. Once the two electrons are being correlated, the relation will exist whatever may be their spatial or temporal separation. This relation is holistic in nature. Each entity in this universe is supposed to be related to the other one, and one can think of a universal network. By knowing the property of entanglement, one infers the property of the individual objects but not the reverse one.

Guiding Questions for the Dialogue: Buddhist scholar Dharmakirti studied extensively about the reality of relations in his philosophy of relations (sambandhapariksha). Jaina scholars also discussed about the relation and its reality. Many other eminent scholars from other traditions in Indian philosophy like Nyaya School debated on the issue of reality of relations. What are views on reality of relations? The challenging issue is whether the relation is equally real as of relatum?

v. Quest for Ultimate Reality: Modern Physics and Ancient Wisdom:

Both scientists and philosophers are trying to understand the ultimate reality. Philosophy asks “Why this existence?” Science asks “How this existence?” The moment you ask the question “how”, method and technique become important. Science has developed its own methodology in search of reality. Some schools in our ancient wisdom (for example, Tantra) emphasize the use of techniques and methods in search of ultimate reality.

Guiding Questions for the Dialogue: In science, we use symbols and deal with conceptualised knowledge at each level of reality. Whether methods and techniques are also needed in Indian philosophy to realize the ultimate reality? Is it necessary to go beyond conceptualised knowledge for ultimate reality?

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Tata Education Trusts

Tata Trusts seek to be the catalysts in development through providing grants to institutions in the areas of Natural Resources Management, Rural and Urban Livelihoods, Poverty, Education, Enhancing Civil Society, Governance, Health, Media Arts, Crafts and Culture.

Sir Dorabji Tata Trust and the Allied Trusts (SDTT & AT) are among India’s oldest, non-sectarian philanthropic organizations. Since their inception, the Trusts have been working to empower the economically weak and socially backward sections of society. The work of the Trusts is concentrated in the poorest regions of India, where they work in an integrated manner through myriad interventions across Natural Resources Management & Rural Livelihoods, Health, Education, Urban Poverty & Livelihoods, and Media, Art & Culture. Sir Ratan Tata Trust, set up in 1919, has played a pioneering role in changing traditional ideas of charity and introducing the concept of philanthropy to make a difference to the community.

Through its grant-making and direct implementation strategy, the Trust supports the following thematic areas: Education, Health, Arts, Craft & Culture, and Rural Livelihoods & Communities. The Trust also makes individual grants for education, medical relief and sports. The Navajbai Ratan Tata Trust, formed in 1974, also embodies a similar approach.

Source: http://tatatrusts.org/

Tata Steel

Tata Steel Group Profile

Tata Steel, the flagship company of the Tata Group, has a crude steel production capacity of nearly 30 million tonnes per annum (MnTPA). A Fortune 500 company, the Tata Steel Group is the world’s second-most geographically diversified steel producer, employing over 80,000 people in nearly 50 countries. The Group’s vision is to be the world steel industry benchmark in “Value Creation” and “Corporate Citizenship” through the excellence of its people, its innovative approach and overall conduct. The Tata Steel Group recorded a turnover of US$ 24.81 bn in the year ended March 31, 2014.

Tata Steel’s global journey began with the aim of achieving a larger geographic footprint and servicing a global customer base, including the mature markets of UK and Europe and the fast-growing markets in South East Asia and China. Apart from its Indian operations, the Tata Steel Group today comprises mainly its European operations through Tata Steel Europe (www.tatasteel europe.com) and its South-East Asian operations through Tata Steel Thailand (www.tatasteelthailand.com) and Natsteel (www.natsteel.com.sg).

Indian Operations

Established in 1907, the Jamshedpur Works of Tata Steel has a crude steel production capacity of approximately 10 MnTPA and a variety of finishing mills. Tata Steel has a significant presence in allied and downstream areas through its Strategic Business Units, namely Tubes Division, Bearings Division, Wire Division, Ferro Alloys & Minerals Division and Tata Growth Shop, which develops and manufactures specialist, high-precision industrial equipment.

The Company is setting up a 6 MnTPA green-field steel project at Kalinganagar in Jajpur district of Odisha. The project is being set up in two phases of 3MnTPA capacity each. Tata Steel is also examining further capacity enhancement through green-field projects in Jharkhand, Chhattisgarh and Karnataka, etc. The company also
possesses and operates captive iron ore, coal and chrome ore mines.

In 2012, Tata Steel became the first integrated steel plant in the world, outside Japan, to win the Deming Grand Prize, the highest honour in quality instituted by the Japanese Union of Scientists & Engineers. Earlier, in 2008, Tata Steel India became the first integrated steel plant in the world, outside Japan, to be awarded the Deming Application Prize 2008 for excellence in Total Quality Management.

Corporate Sustainability — the Tata Steel way
Tata Steel was founded on the philosophy that the community is not just another stakeholder in business, but is, in fact, the very purpose of its existence. The CSR activities of the Company have expanded to over 800 villages in the States of Jharkhand, Odisha and Chhattisgarh.

Tata Steel is a valued member of the World Steel Association (worldsteel) and has accepted a set of sustainability indicators to measure its triple bottom-line performance within the steel industry. Tata Steel is a founder member of the United Nations Global Compact Programme. The Company is also guided by frameworks such as the UN Millennium Development Goals.

Tata Consultancy Services
Tata Consultancy Services (TCS) is an IT service, consulting and business solutions organization that delivers real results to global business, ensuring a level of certainty that no other firm can match. TCS offers a consulting-led, integrated portfolio of IT, BPS, infrastructure, engineering and assurance services. This is delivered through its unique Global Network Delivery Model™, recognised as the benchmark of excellence in software development. A part of the Tata group, India’s largest industrial conglomerate, TCS has over 319,000 of the world’s best-trained consultants in 46 countries. The company generated consolidated revenues of US $15.5 billion for the year ended March 31, 2015 and is listed on the National Stock Exchange and Bombay Stock Exchange in India. For more information, visit www.tcs.com.

Indo-US Science and Technology Forum
The Indo-US Science and Technology Forum (IUSSTF), established under an agreement between the Governments of India and the United States of America in March 2000, is an autonomous, not for profit society that promotes and catalyzes Indo-US bilateral collaborations in science, technology, engineering and biomedical research through substantive interaction among government, academia and industry. As a grant making organization, the principle objective of IUSSTF is to provide opportunities, to exchange ideas, information, skills and technologies, and to collaborate on scientific and technological endeavor of mutual interest that can translate the power of science for the benefit of mankind at large.
Cognitive Science Research Initiative (CSRI), Department of Science and Technology, Government of India

Cognitive Science is the study of human mind and brain, focusing on how mind represents and manipulates knowledge and how mental representations and processes are realised in the brain. The field is highly transdisciplinary in nature, combining ideas, principles and methods of psychology, computer science, linguistics, philosophy and neuroscience, etc. In Indian scenario, which is full of diversity, it is important to foster scientific research in interdisciplinary field of cognitive science for better understanding of Indian mind sets, languages and cognitive disorders, etc. With this aim, the Department of Science and Technology (DST) had initiated a highly focused programme “Cognitive Science Research Initiative (CSRI)” in 2008 during 11th five year plan. The CSRI facilitates a platform to scientific community to work for better solution for challenges related with cognitive disorders and social issues through various psychological tools and batteries, early diagnosis and better therapies, intervention technologies and rehabilitation programmes.

Science and Engineering Research Board (SERB), Government of India

One of the most notable developments in the science and technology sector in the XI Plan has been the setting up of the Science and Engineering Research Board (SERB) through an Act of Parliament, viz. the Science and Engineering Research Board Act, 2008. Promoting basic research in Science and Engineering and providing financial assistance to persons engaged in such research, academic institutions, research and development laboratories, industrial concerns, and other agencies for such research and for matters connected there with or incidental thereto are the primary and distinctive mandate of the Board.

SERB aims to build up best management systems, which would match the best global practices in the area of promotion and funding of basic research.

Source: http://www.serb.gov.in/about.php