

Indian Institute of Technology Mandi



Presents

**MIND, BRAIN, AND CONSCIOUSNESS CONFERENCE
PERSPECTIVES FROM INDIAN KNOWLEDGE SYSTEM (MBCC-
2023)**

**Organized by the Indian Knowledge System and Mental Health
Applications (IKSMHA) Centre, IIT Mandi**

Dr Varun Dutt, Chair

Dr Arnav Bhavsar, Publication and Peer review

Dr. Chayan, Dr. Amit Prasad, Publication and Peer review

Dr. Kunal Mooley, Publication and Peer review

Dr Laxmidhar Behera, Patron



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About The Conference

The conundrum of finding a consistent first principle causal mechanism for the origin of consciousness and conscious experience has virtually baffled the greatest thinkers of our time. Despite ongoing advances in consciousness studies, we have not been able to answer the so-called ‘hard problem’ of consciousness satisfactorily. Interestingly, Indian Knowledge Systems (IKS) have addressed the issue within a holistic framework without necessarily adhering to the physicalist and reductionist paradigms of modern science. Specifically, IKS provides several interventions from the yoga sutras, Sankhya, Ayurveda, and other traditional texts. These interventions may include yoga, meditation, ayurveda, and other Indian performing arts. Thus, there is a great need of imbibing the insights from IKS and its numerous interventions to solve the fundamental questions in relation to consciousness and conscious experience for cognitive wellness and mental health. The international conference, “Mind, Brain, and Consciousness (MBC): Perspectives from Indian Knowledge System,” organized by the Indian Knowledge System and Mental Health Applications (IKSMHA) Centre, envisages a healthy discussion among scientists and philosophers on consciousness as well as different IKS interventions for cognitive wellness and mental health. The conference will be the first of its kind to bring together scholars from all walks of life, i.e., neuroscientists, psychologists, AI and robotics researchers, physicists, mathematicians, biologists, computer scientists, traditional scholars and practitioners of Indian Knowledge Systems, etc. We welcome papers and posters from all the areas mentioned above. The conference will have plenary talks, parallel sessions (for paper and poster presentations), and brainstorming panel discussions.

Plenary Talks

Unleashing the Talent Within - an insider's insights on conquering and befriending the mind and the body with consciousness to translate potential to substantial contributions.

Sh. Chitravina Ravikiran
Senior Sangeet Natak Akademi Awardee

Abstract:

This talk will share insights through illustrative first-hand examples on how genius can be created and nurtured. Questions discussed will include: What sets apart genius apart from normal experts and achievers? Can tapping into the depths in one field open doorways to others? How the inherently multi disciplinary and unitary nature of Indian Knowledge Systems subliminally embedded in cultural practices is a fertile field for fostering the blossoming of genius not only marked by exceptional competence and originality, but also an inclusive outlook beyond oneself for societal and global well-being. The pointers in this talk could ignite inspiration to embark on an exciting journey of professional excellence and personal fulfillment and also highlight how true evolution is about treating personal development and possible successes as mere platforms to contribute towards larger causes.

Bio:

Sh. Ravikiran is among the most significant contributors to Indian Music and Culture from age 2, when he stunned the world as a 2-year-old prodigy, identifying and demonstrating 325 Indian Classical Ragas (Scales/Modes) and 175 talas (Time Signatures), inspiring Sitar icon Pt Ravi Shankar to declare, 'If you don't believe in God, look at Ravikiran'. He presented vocal concerts between the age of 5 and 10 across India with top co-artists in prominent venues. From age 12, he has been entralling audiences in numerous countries on the 21-stringed slide, Chitravina and is rated as one of the all-time greats of Indian music.

Ravikiran is widely regarded as a most prolific and inventive composer with over 1050 Music, Dance and Western Orchestral compositions to his credit, which include operas such as Ramayana and Mahabharata. His historic achievements include setting to music the entire 1330 Thirukkural verses of Tiruvalluvar in merely 16 hours and creating a set of 108 original compositions on the 108 Divya Deshams of Vishnu in only 45 days. Inventor of the paradigm-shifting concept of Melharmony, which explores new chords and counterpoints based on melodic progression, Ravikiran has introduced over 100 Indian Ragas to Western Orchestras and World Music Ensembles, collaborated with frontline artists

of diverse genres, mentored numerous award-winning performers and educators, initiated distance learning and online courses in Indian music, penned scores of books and articles, raised substantial funds for educational, health and social initiatives like the Musicians' Covid Relief Fund, pioneered Rural Empowerment through Music and Arts Education and initiated Climate Literacy and Action Drives to prevent an environmental meltdown in the planet. Ravikiran has been decorated with numerous Awards and Titles in several countries, in many instances being the first or youngest to receive such honors, including the President of India's Senior Sangeet Natak Akademi Award at age 39. He attributes all his success to the revolutionary guru, Chitraivina Narasimhan, the iconic T Brinda and the legends who have inspired him.

Understanding Science and Technology in IKS - Origins, Benefits, and Limits

Prof. K. Ramasubramaniam
IIT Bombay

Abstract:

During the talk, we will endeavor to address questions such as: What does Indian Knowledge Systems (IKS) refer to? When did they originate? What are the key features that we need to know about IKS, including their history and evolution? Why is it important to study them? How do individuals and societies benefit from studying them? Do they encompass science and technology? What precautions should be taken before arriving at conclusions?

Bio:

A world-class Indic scholar of great repute, a historian of Indian Sciences in Mathematics and Astronomy, Sanskrit Guru, Vedic Teacher and Indian Philosopher. His immensely broad erudition, his insights and his popular teachings have been inspiring a new generation of thousands of students, other scholars and teachers to learn and undertake research on the riches of India's scientific heritage and enabling its preservation. His creative and exciting teachings at IIT Bombay and his unique, unparalleled multi-disciplinary scholarship continues to make an impact with a powerful combination of Science, Sanskrit and Spirituality. His life's mission has been to inspire society to undertake research and give India its rightful place in the world of history of science and ignite interest in Sanskrit as a language of science.

Could Perception be the second name of Maya?

Honorable Dr. Sonal Mansingh
Padma Vibhushan, Padma Bhushan Awardee

Abstract:

To be able to See, Observe is natural activity for all, but to rise higher to a vantage point from where one perceives things beyond sensory organs, to go beyond body-mind consciousness is something inherent in our Bharatiya dance systems. On offer is a magical mysterious process of learning, searching & experiencing.

Bio:

Sonal Mansingh's dancing career which started in 1962, after her arangetram in Mumbai, and in 1977, she founded, Centre for Indian Classical Dances (CICD) in New Delhi. Over the years, dance has taken her all over the world[15] and brought her many awards, including the Padma Bhushan (1992), Sangeet Natak Akademi Award in 1987, and the Padma Vibhushan, India's the second highest civilian award, in 2003; making her the second woman dancer in India to receive such an honour after Balasaraswati. This was followed by Kalidas Samman of Madhya Pradesh government, in 2006 and on 21 April 2007, she was conferred with Doctor of Science (Honoris Causa) by G.B. Pant University, Uttarakhand at Pantnagar and Doctor of Literature (Honoris Causa) by Sambalpur University. To mark the completion of her 40 years in dancing in 2002, noted Hindi film director, Prakash Jha made a documentary film on her, titled Sonal, which also won the National Film Award for Best Non-Feature Film for the year. In 2018, she was honoured with Sangeet Natak Akademi Fellowship also known as Akademi Ratna, for her contribution in the field of performing arts.

The ‘Quantum Underground’ – Where Life Defeats Decoherence and Enables Non-local Consciousness

Prof. Stuart Hameroff

University of Arizona

Abstract:

Biology is said to be too ‘warm, wet and noisy’ for functional quantum mechanisms, but living systems are highly heterogeneous, consisting of varying drug solubility compartments. Most drugs are polar, water-soluble, and act by binding to charged surface receptors. But anesthetic gasses which selectively block consciousness are non-polar, uncharged, water-insoluble, and bind and act in brain proteins by weak quantum van der Waals forces. This implies consciousness occurs in non-polar, ‘hydrophobic’ (water excluding, thus not ‘wet’) fat/oil-like regions with low Hildebrand solubility coefficient λ 15.2 to 19.3 SI units (‘oil and water don’t mix’). These regions consist largely of organic rings of aromatic amino acids in protein interiors, regions of delocalized clouds of ‘pi electron resonance’. When properly arrayed geometrically, these intra-protein clouds couple, oscillate in terahertz and support quantum optical effects (fluorescence, exciton transfer, optical phonons, super-radiance, entanglement). Tubulin proteins geometrically arrayed in microtubules each have 86 aromatic amino acid rings which extend to boundaries with adjacent tubulins in microtubule lattices. Thus non-polar, quantum-friendly regions can entangle between tubulins through microtubule lattice helical pathways, extending mesoscopically and macroscopically. At ambient temperatures, microtubules have coherent excitations and resonance patterns (‘triplets-of-triplets’) in kilohertz, megahertz, gigahertz and terahertz (thus warm, but not ‘noisy’, discovered by Anirban Bandyopadhyay), and quantum optical effects inhibited by anesthetics. The anesthetic-soluble non-polar regions within microtubules (‘quantum underground’) appear to act as adiabatic, decoherence-free subspaces. Coherent microtubule excitations and resonances are driven by ambient temperature (so ‘warm’, but not ‘noisy’). Helical pathways of superpositioned tubulins in microtubules may act as ‘topological qubits’ to provide quantum error correction. Deep within biomolecules, a ‘quantum underground’ pervades and organizes cells and living systems. Life itself, as Schrodinger suggested, is a quantum mechanism, and consciousness can be non-local.

Bio:

Stuart Hameroff MD is Emeritus Professor of Anesthesiology & Psychology, Director of the Center for Consciousness Studies, and attending anesthesiologist at Banner-University Medical Centers, all at the University of Arizona in Tucson, Arizona. With an undergraduate interest in consciousness, Hameroff researched cell division/mitosis in medical school, specifically how mitotic spindle microtubules precisely recognized and moved chromosomes. Comparing the microtubule lattice structure to computer matrices, Hameroff proposed that microtubules were computer-like sources of biological intelligence and consciousness. In the early 1990s Hameroff teamed with famed British physicist and Nobel Laureate Sir Roger Penrose to develop the controversial Orch OR quantum theory of consciousness in microtubules. Since then he has worked to test and validate Orch OR, including studies of actions of anesthetic gases on microtubule quantum processes. As microtubules have been found to have coherent excitations in kilohertz, megahertz, gigahertz and terahertz frequencies, Hameroff helped pioneer ‘transcranial ultrasound’ (megahertz vibrations) to treat mental and cognitive disorders. Hameroff also co-founded the University of Arizona’s Center for Consciousness Studies and directs its annual ‘The Science of Consciousness’ conferences.

Yoga and Consciousness in Education

Dr. Antonietta Rozzi

Founder Sarva Yoga University

Abstract:

Since the dawn of civilisations, the subject of consciousness, that capacity “to be aware to know” has been a mystery to be unveiled with philosophical and scientific symbolism and theories. Even today, modern science is still confronted with this function that towers above the human mind, which can observe and control it, thus also sometimes assuming moral and ethical connotations. In yoga, consciousness is both the primary tool and the ultimate goal: a state capable of revealing, if not fully explaining, the mysteries of creation and human existence. Yoga has thus structured practical paths capable of modifying ordinary states of consciousness and opening wider horizons of knowledge that only a different state of consciousness is able to reach and manifest. Only an expanded consciousness, according to yoga, can see and unveil the great mysteries of the origin of creation, of life and the meaning and value of human existence. This different consciousness alone can answer the existential questions that have anguished the human species since time immemorial: who am I? Who created everything? Where to go after this earthly existence? Who is that Creator? In every human being there is an instance capable of asking these questions but without finding the answers in the ordinary mind. In modern societies, excessive materialism risks stifling any evolutionary impulse of consciousness. The education of the new generations can guarantee balanced personalities capable of living together in peace for the sake of global well-being with respect to the environment and life. The ancient science of yoga, which focuses on the exploration of consciousness in its many possible modulations, is a useful and effective tool in today's society for balanced growth, improved learning and peaceful coexistence and social well-being.

Bio:

She graduated in literature and philosophy in France and obtained a master's degree in modern languages and literature in Italy, University of Parma. She started practicing yoga 45 years ago. She visited many yoga schools and ashrams in India and organized intensive yoga programs for Italian yoga students and teachers. She followed the teachings of great masters in Europe and India, such as Swami Chidananda and Swami Krishananda of the Divine Life Society, Swami Satyananda of Monghyr, Swami Rama, Swami Satchidananda and many others and cooperate with the main Indian yoga Institutions and universities. She is Senior professor of the Italian Yoga Federation for 45 years and has

contributed to the revision of the Initial Training Program for yoga teachers adopted by many European federations of yoga. She is Director of Yoga Educational Institute and has been a member of the Italian Commission of the Ministry of Education to develop official programs of yoga at schools, colleges and universities. She has been nominated as a member of the Commission of AYUSH Ministry and WHO for Public Health programs.

She teaches Yoga in Education as an official course at the University of Bologna and Bolzano (Italy). She has been appointed by the WHO and the Government of India as a member of the International Commission of Experts for the Implementation of Global Health Programmes through Yoga promoted by the World Health Organization. She is founder and President Sarva Yoga International, Leading Yoga Institution accredited by YCB of Ministry of AYUSH, Government of India. In 2019 she has been awarded by Honorable Prime Minister Narendra Modi with the “Prime Minister's Awards for Outstanding Contribution of Promotion and Development of Yoga”. She founded Sarva Yoga University and collaborates with leading Italian and Indian yoga universities.

Harmonizing Rhythms: Exploring the Correlation Between Vedic Tripura Tala and Protein Resonance Bands

Dr. Anirban Bandyopadhyay
NIMS, Tsukuba, Japan

Abstract:

We focus on the Vedic musical tala, specifically the "tripura tala" based on the prime number 3, consisting of three cycles of beats, each further divided into three beats. Surprisingly, this rhythmic pattern, a fundamental element in Vedic music, is also observed in the resonance band of proteins, which we refer to as the "triplet of triplet band." Statistical analysis reveals it as the most dominant symmetry of rhythms.

Furthermore, our investigation extends beyond the world of music and proteins. We explore how basic changes in geometric shapes are adopted as knots and other forms of invariants in Vedic dance, music, art, food, culture, and festivals. We emphasize the intimate relationship between the symmetry of prime numbers and these geometric changes, enabling us to construct mathematical models that shed light on various cognitive and conscious elements. This interdisciplinary approach offers a fresh perspective on the unanticipated harmony between ancient Vedic rhythms and the intricate world of proteins, paving the way for new insights into both music and biology.

Bio:

Anirban Bandyopadhyay is a Senior Scientist in the National Institute for Materials Science (NIMS), Tsukuba, Japan. He possesses a Masters of Science in Condensed Matter Physics, Computer, Numerical Analysis, and Astrophysics from North Bengal University and a Doctor of Philosophy in Physics from Jadavpur University. He received his PhD from the Indian Association for the Cultivation of Science (IACS), Kolkata 2004-2005, where he worked on supramolecular electronics and multi-level switching. Bandyopadhyay has developed a resonance chain based complete human brain model that is fundamentally different from Turing tape, essentially developing an alternate human brain map where filling gaps in the resonance chain is the key. He has developed a unique quantum music measurement machine and experiments on DNA proteins, microtubules, neurons, molecular machines, and cancer. Bandyopadhyay has also developed a new frequency fractal model. His group has designed and

synthesized several forms of organic brain jelly that learns, programs and solves problems by itself for futuristic robots as well as several software simulators that write complex codes by themselves.

Invited Talks

The role of pre-natal yoga protocol in managing pregnancy: mechanistic insights for memory enhancement

Dr. Akshay Anand

PGI Chandigarh

Abstract:

Our study aimed to investigate the impact of prenatal Yoga on pregnancy outcomes and the potency of umbilical cord blood (UCB) derived lineage negative (Lin-ve) stem cells. We examined pregnant women aged 18 to 35 who practiced Yoga from the 16th to 18th week of pregnancy until delivery. The study also involved an animal model of brain injury induced by Amyloid beta (A β) administration in mice. After Yoga intervention, UCB was collected from the participants, and Lin-ve stem cells were analyzed. Flow cytometry revealed an increased number of CD34+ve cells in the Lin-ve population in Yoga group participants, indicating enhanced stemness. For the animal model, Lin-ve stem cells from Yoga practitioner mothers and usual care group mothers were injected into mice with A β -induced memory loss. Neurobehavioral tests showed improved memory in both transplantation groups, with the Yoga group showing greater improvement. mRNA expression of BDNF, Nestin, and CREB was marginally increased in the Yoga group. Protein expression of BDNF was significantly higher in the brain of mice who received stem cells from Yoga group as confirmed by IHC. These results suggest that Yoga during pregnancy can impact stem cells at a cellular level, potentially enhancing the efficacy of UCB-derived stem cells. Embracing Yoga as a lifestyle during pregnancy may lead to improved outcomes, and Lin-ve SCs derived from Yoga practitioners could be considered a valuable source for stem cell banking.

Bio:

Akshay Anand graduated from Post Graduate Institute of Medical Education and Research (PGIMER). After obtaining his post-doctoral training at the same Institute, he joined the University of Kentucky as Scientist II. After serving there for two years, he returned to join faculty of Department of Neurology PGIMER. He was instrumental in setting up the Neuroscience Research Lab which is compliant to GLP principles. He is a strong advocate of science entrepreneurship and integrative health paradigm. Dr Anand is a research improvement specialist who is interested in understanding the molecular mechanisms of neurodegeneration utilizing invitro, invivo, alternative and biotherapeutic approaches. His other research interests range from analyzing the role of genetic and other risk factors that modify

ALS and AMD to screening of novel drugs and Yoga modules for memory enhancement and wellness. He has also been involved in the discovery of animal model of AMD published in Nature Medicine. Dr Anand was nominated for prestigious Padma Award, 2020 besides being honored by UT Police for exemplary work in advancement of Yoga research. He has been awarded for ICMR Amrut Mody Unichem Prize-2012, Annual PGI faculty award-2013, 2014, Sardar Vallabhbhai Patel Foundation 9th International Prestigious Sardar Patel Award, 2014, ICMR Shankuntla Amir Chand Award (2010), Young Scientist Award from DAE (2005), Retina Research Foundation / Joseph M. and Eula C. Lawrence Award (2003), Runners up for NASI Scopus Award for Biological Sciences (2012), served as Judge at ISEF, USA (2002-3), obtained over 2 dozen International travel awards besides mentoring his PhD students to lead the Swacch Bharat campaign for which the team was awarded the Bharat Nirman Award in the Behavioral change category by Ministry of Science and Technology (IISF, 2017). He is the Editor in Chief of Annals of Neurosciences the official journal of Indian Academy of Neurosciences and Journal of Integrative Medicine Case Reports (IMCR), the official Journal of Swami Paramhansa Samsthana, former EIC of Integrative Medicine International, the official journal of Karger besides serving on Editorial board of Nature Scientific Reports and Neuroepidemiology. He is also Reviews Editor of Frontiers in Behavioral Neurosciences and on Editorial Advisory Board, User-Driven Healthcare and Narrative Medicine: Utilizing Collaborative Social Networks and Technologies and other International Journals. Dr Anand is the guest faculty in the Human genomics program of Panjab University and former advisor to the local chapter of Indian Muscular Dystrophy Association. He has over 217 publications (194 as corresponding author) in International peer reviewed Journals besides filing 4 patent applications. He was also designated Expert on Mission by ICGEB, Trieste for Intellectual property and is the resource faculty for various national and international forums and academic and regulatory committees. He serves as Visiting Professor of Kyoto University of Medicine and Visiting Distinguished Professor in Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) and earlier served with Lesya Ukrainian Eastern European National University, Lutsk and Sri Sri Institute of Advanced Research, Bengaluru as its Visiting Scientist. He has continued to remain funded for research since he joined as faculty with an average of 4-5 grants at any point.

Brain Oscillatory dynamics and Consciousness: Impact of meditation proficiency

Prof. Amit Sethi

U. Philadelphia, Occupational Therapy

Abstract:

This presentation will present an overview of the various modalities of non-invasive brain stimulation (NIBS), such as transcranial magnetic stimulation (TMS) and transcranial electrical stimulation (TES). The diagnostic application of single-pulse TMS will be presented in motor rehabilitation after neurological disorders such as stroke. The therapeutic application of repeated TMS and TES will be provided for motor and cognitive rehabilitation after stroke and Alzheimer's disease. I will also present an application of TES with meditation (mindfulness) in improving anxiety

Bio:

Amit Sethi is an Associate Professor in the Department of Occupational Therapy and the Director of the Master's in Occupational Therapy program at the University of Pittsburgh. He completed his bachelor's in occupational therapy from Manipal College of Allied Health Sciences, India, his Master of Science in Occupational Therapy from the University of Wisconsin Milwaukee, and his PhD in Rehabilitation Sciences from the University of Florida. He is the Director of the Neuromotor Recovery and Rehabilitation Lab. The focus of his research program is to understand the mechanisms of recovery to inform the development of interventions and technologies to improve motor function in adults post-stroke. His research is funded by the National Institutes of Health, USA and he has published in several peer-reviewed Tier 1 journals.

Prof. Laxmidhar Behera

Director IIT Mandi

Abstract:

Bio:

Prof Laxmidhar Behera is currently working as the Director, IIT Mandi on deputation from IIT Kanpur. He served as TCS affiliate faculty during 2021-22. During his 27 years of research and teaching career, Prof Laxmidhar Behera has contributed significantly to areas such as Intelligent Systems and Control, Vision based Robotics, Warehouse automation, Brain-Computer-Interface and Drone Technology. His work has a unique blend of theory and experiments. He has established industrial collaboration with TCS, Renault Nissan, and ADNOC, Abu Dhabi, BEL Bangalore while making significant technological development in the areas such robotics-based ware-house automation, vision and drone guided driver assistance system, and drone guided pipeline inspection systems. His team secured 3rd position in the Amazon Robotics Challenge 2017 among top 16 teams across the globe and 4th position in the stow-cum-pick event. He has supervised 24 PhD students to completion and currently supervises 14 PhD students. Besides, he has supervised more than 70 masters' dissertations. He has published three graduate level text books, 110 peer reviewed journal papers, 208 papers in conference proceedings and 17 book chapters. His book entitled Intelligent Systems and Control published by Oxford University press is now in its 5th reprint and is being prescribed as a graduate level text book in many Universities across the world. Recently (April 2020) he published another book on Intelligent Control of Robotic Systems by CRC press Taylor & Francis – this book has been selected as the best Engineering book of the year 2020-21. Six of his papers have been given best paper awards in International/National conferences. He has established international research collaborations with ETH, Zurich, University of Texas, San Antonio, University of Edinburgh, UK, University of Ulster, UK, NAIST, Japan, and Deakin University, Australia. He has worked as Reader at University of Ulster, UK during 2007-2009 and has taken up visiting professor assignments at ETH Zurich, and FHG, Germany. He has acted as associate editors of two International Journals published by Taylor & Francis and Hindwai. He currently serves as the Associate Editor of IEEE Trans Systems, Man and Cybernetics: Systems. He is a fellow of INAE and senior member of IEEE

Brain Oscillatory dynamics and Consciousness: Impact of meditation proficiency

Prof. Bindu Kuty
NIMHANS Bangalore

Abstract:

Consciousness refers to the qualitative internal state of our subjective awareness and experience. Deciphering the neurobiology of consciousness, ie. to decipher, how our experience emerges from brain activity, remains a scientific challenge even today. Neuroscientists study the complexity of brain functions especially the EEG dynamics to see how changes in EEG dynamics bring qualitative changes associated with dynamics of self-awareness. Thus, to decipher consciousness, we need to follow a reductionistic approach –from the vantage point of an individual consciousness only. Even by this approach we get to understand many dimensions of mind from mind wandering to achieving non duality, dissociation of self from other mental attributes and its neural correlates etc. My team, at the Center for Consciousness studies, NIMHANS, uses meditation studies as a model to understand such dynamics of mind owing to its ability to induce various aspects of experience dependent brain plasticity. Enhanced theta and alpha activity have been shown to be an index meditation proficiency and is considered as the neurophysiological signatures of trait characteristics of meditation proficiency. Enhanced theta activity is an indication of sustained attention and awareness, positive emotion, feeling of happiness, enhanced self-Regulation, decreased self-referential processing and enhanced objective stance towards oneself. Two psychological processes are thought to underlie the evolutionary process of mental transformation in advanced meditators - they diminish the distinction between ‘self and other’ and increase the sense of oneness. These processes are experiential defusion (detachment from the contents of consciousness) and cognitive dereification (reduction of the experience of the narrative self and its perceptions as accurate portrayal of reality). How meditation practices alter the brain oscillatory dynamics to attain such meta cognitive states? How such changes in brain oscillation bring or lead to behavioural and experiential transformations? May be much nuanced approaches such as psychometric studies together with neuro- phenomenological approaches, would enable such possibilities. Overall, meditation practices and proficiency across traditions are important determinants of experiencing met awareness. It is imperative to undertake much nuanced neuro-phenomenological approaches to explore the neural correlates of transformation of self in health and disease states.

Bio:

Dr. Bindu M. Kutty is Senior Professor of Neurophysiology, Dean of Basic Sciences, and Officer-in-Charge for Centre for Consciousness Studies of the National Institute of Mental Health and Neurosciences (NIMHANS) in Bangalore, India. She has twenty-seven years of teaching and research experience in neurophysiology at the Institute and served as former professor and head of the Department of Neurophysiology guiding and co-guiding 34 students during her tenure. She established the Centre for Consciousness Studies at NIMHANS in 2019 with a mission to build a platform for undertaking multidisciplinary research in the domains of science, humanities and culture pertaining to consciousness by integrating Indian philosophical wisdom with neuroscience.

Srila Prabhupada views of Consciousness – the hard problem of physics

Mr. Bob Cohen

BIHS Florida

Abstract:

Srila Prabhupada named his first science conference "Life Comes From Life," because he posited that consciousness is antecedent to biological life, challenging the prevailing notion that consciousness is a mere emergent property of material interactions. Employing the traditions Gaudiya Vaishnava Sankhya philosophy as an analytical framework, Prabhupada sought to delineate the functional boundaries between consciousness, the mind, and the brain. This theoretical framework opens new interdisciplinary avenues for explanatory research into the nature of consciousness.

Within this paradigm, Prabhupada coined the term "Krishna Consciousness" to encapsulate his presentation of Gaudiya Vaishnava Vedic wisdom. The fundamental premise here is that a nuanced understanding of individual consciousness can lead to an broader epistemological grasp of what Prabhupada terms the 'Supreme Consciousness.' And by providing a rigorous academic structure to Prabhupada's conceptual ideas, this study aspires to contribute meaningful insights to the greater and ongoing dialogue about the nature and origins of consciousness.

Bio:

Bob Cohen has degrees in Chemistry and Geology. He is the Executive Director of the Bhaktivedanta Institute for Higher Studies and one of the original members of the BI having presented at the 1977 conference Life Comes from Life. He has a many faceted career in environmental sciences, court certified mediator, school headmaster among other endeavors. He met Srila Prabhupada in 1972 while a Peace Corps Teacher in Bihar, India. His conversation with Prabhupada was memorialized in the book "Perfect Questions/Perfect Answers" which is available in 62 languages.

Deciphering the moral social emotions

Prof. Braj Bhushan

IIT Kanpur

Abstract:

Behavioural science considers disgust, anger, shame, guilt, pride, compassion, and gratitude as moral emotions. While disgust and anger have also been accepted as basic emotions, the remaining are largely social emotions. This talk will delve into the observed similarity/dissimilarity among guilt, shame, and remorse as complex social/moral emotions based on the findings of three empirical studies. While two of these studies adopted pure behavioural techniques, the third study explored the body physiology changes as reflected through thermal signature. Statistical findings suggested that same scenario can induce guilt as well as shame or remorse depending on the valence. While scenarios with positive factor load elicited guilt, shame and remorse inducing scenarios had negative factor load. These three emotions were marked by a difference of 0.5°C or above change in temperature on the forehead, left and right cheeks, and mouth regions during guilt experience compared to shame and remorse experiences. These thermal changes can be understood with respect to the distribution of blood vessels on the face. With respect to personality factors, openness to experience reliably distinguished guilt and shame in males, and conscientiousness between guilt and remorse in females. Neuroticism predicted guilt in males. The findings suggest interplay of personality and moral emotions. Besides criminal and corrective justice, the findings have implications for affective and computational neuroscience.

Bio:

Braj Bhushan is Pavitar Joneja Chair Professor of Psychology in the Department of Humanities & Social Sciences at IIT Kanpur. He is currently the Dean of Administration. He has extensively worked in the area of psychological assessment and neurodevelopmental disorders. He has also served Kyushu University, Japan as a Visiting Professor. Besides being member of Board of Studies of several universities in India, he has served as member of the Advisory Committees of Psycho-Technical Directorate, Research Designs and Standards Organisation (RDSO), Lucknow and Defence Institute of Psychological Research, DRDO, Delhi. He was elected Fellow of the British Psychological Society in 2023 and Fellow of the Association for Psychological Science, USA, in 2022. The most recent accomplishments of Professor Bhushan are development of the Brain Based Intelligence Test (2021) and Assistive Application for Children with Dyslexia and Dysgraphia (AACDD, 2019).

Developing the science of matter, mind and consciousness leveraging IKS and scientific tools

Dr. Kunal Mooley
Caltech, USA

Abstract:

Various lines of observational evidence (e.g. reincarnation, out-of-body and near-death experiences, extra-sensory perception and spiritual experiences), as well as philosophical arguments (e.g. the hard problem of consciousness and quantum mechanical interpretations), indicate that the mind and consciousness go beyond the physical body. While this conclusion is in accordance with the Indian Knowledge System (IKS; with some parallels with other traditions worldwide), the enduring mind-brain problem has inhibited the wide acceptance, within mainstream science, of mind and consciousness beyond the brain. I will present a unique research program leveraging the metaphysical tools and meditative practices described in the IKS, as well as sophisticated experimental, computational and theoretical approaches offered by modern science and philosophy, to develop a more comprehensive understanding of matter, mind and consciousness and reality.

Bio:

Kunal Mooley is a Research Scientist at Caltech. He studies cataclysmic events, such as supernovae (deaths of stars) and neutron star mergers (gravitational wave sources), in the cosmos using a wide suite of telescopes such as the Karl G. Jansky Very Large Array (VLA), Very Long Baseline Array, Chandra and Keck. Kunal is currently co-leading JAGWAR, a worldwide collaboration to study astrophysics and cosmology using gravitational wave sources. Recently, he has initiated research on the perception of space and time, mind, consciousness and the nature of reality. Kunal obtained his Ph.D. in Astrophysics in 2015 from Caltech, where he implemented a new radio observing mode on the VLA, thus revolutionizing widefield radio surveys and discovering new populations astrophysical transients. Kunal later moved to the University of Oxford as a Hintze Fellow to study relativistic jets in accreting black holes, neutron stars and white dwarfs. In 2018, he took on the Jansky Postdoctoral Fellowship jointly between the National Radio Astronomy Observatory (NRAO) and Caltech, where he developed precision astrometric techniques to study the motion of astrophysical jets, and co-founded the Institute for Mind, Intelligence and Consciousness Studies. Kunal spends most of his time studying our dynamic

Universe as well as the nature of mind and consciousness. Outside of research, he finds great interest in all kinds of sports and performing arts.

Developing an analytical tool to aid discourse between varying theories on the nature, origins and interrelationships of dimensions of conscious experience

Developing an analytical tool to aid discourse between varying theories on the nature, origins and interrelationships of dimensions of conscious experience

Mr. Martin Fleming

Vedanta philosopher

Abstract:

There are many dimensions and aspects of conscious experience which are the subject of extensive research across many disciplines of science and philosophy. Many terms are conflated, others defined too narrowly or too broadly. To this day, there is no theory nor structural framework for the origin and nature of consciousness. Nor is there a systematic tool that enables researchers to articulate their use of terms, concepts or structural approaches in a way that allows comparison and contrast with other theoretical ideas.

This paper will suggest that, despite strongly voiced differences, there is much common ground. In this regard we are assisted by the approach adopted in Indian Knowledge Systems (IKS).

I argue for several axioms:

1. That the philosophical approach of focus on ontological differences is invalid;
2. As with physics, we should focus on defining the functions and properties of the various dimensions of conscious experience; and that
3. These fall into a minimum of three distinct categories of functions/properties.

We thus propose an analytical tool to be used by researchers to indicate their particular commitment with regard to:

- a) the status of each dimension in space and time (both physical and conceptual);
- b) the causal inter-connections that exist between them;
- c) the authority and evidence they use to justify their model of causality.

I will present a framework of consciousness based on IKS insights that can map out multiple theories and show how they relate to one another - regardless of how they lie within the metaphysical spectrum.

Bio:

Akhandadhi das was born in Belfast, Ireland and studied architecture at Bristol University. In 1975 he entered an ashram in the UK to study Vedanta philosophy and took monastic vows. He served as Principal of the Bhaktivedanta Manor theological college from 1982-1995.

He has been a regular contributor on BBC since 1989 and sat on its Central Religious Advisory Board for six years. From 1996, he was director of Buckland Hall in Wales, an open venue for spiritual, philosophical and personal development and training. Currently, he is a director the Science and Philosophy Initiative in the UK, a multi-disciplinary association exploring the issues of consciousness & physical systems principally in neuroscience, biology & physics; and also, of the Bhaktivedanta Institute for Higher Studies (BIHS). His particular area of interest is the metaphysics of consciousness. Is our tendency to be spiritual hardwired in our genes? Genetic correlates of spirituality

Is our tendency to be spiritual hardwired in our genes? Genetic correlates of spirituality

Prof. Nitika Parmar
CSUCI, Mol. Biology

Abstract:

Genes for hormones such as serotonin and dopamine, as well as their transporters have been shown to positively correlate with spirituality and religious experiences. Investigations by various researchers studying personality traits, genomic genotyping and brain density mapping have provided initial evidence that spirituality or being religious may be associated with altered levels of these hormones or presence of varying alleles. Are biological factors responsible for spirituality and religious experiences? Although preliminary studies show some correlation between spirituality and biological factors, more in-depth research is needed to establish a concrete link between biological determinants and spirituality or expression of religion. This presentation is based on other researchers work and will summarize their findings.

Bio:

Dr. Nitika Parmar is a Professor of Biology at California State University, Channel Islands, California. She also leads the MS in Biotechnology program and co-directs the MS Biotechnology/MBA dual degree program. She received her PhD in Molecular Biology and Post-Doctoral Fellowship in Cancer Biology from the University of California, Los Angeles. Her education in India includes a BS in Biophysics from Punjab University, MS in Biotechnology from Pune University and MTech in Biotechnology/Biochemical Engineering from IIT, New Delhi. Her research interests are in the areas of cancer biology, signal transduction pathways, gene silencing and biological screens of gene manipulators. She is the recipient of \$10.5 million grant from the California Institute for Regenerative Medicine (CIRM) to lead the Stem Cell Program on her campus.

Study on the effects of Mantras using signal processing

Dr. Ram Bilas Pachori

IIT Indore

Abstract:

Meditation, having roots in ancient times, has gained popularity in recent years as individuals seek to enhance mental and physical well-being naturally. A growing body of research is dedicated to uncovering the biological mechanisms that underlie the positive effects of meditation. However, despite its ancient origins spanning thousands of years, research investigating the impact of meditation on the human brain remains limited. Various Mantras like Hare Krishna Mahamantra, Rudram Mantra, and other Vedic Mantras play important roles in meditation. This talk will present the effect of Hare Krishna Mahamantra and Rudram Mantra on the human brain based on the analysis of the electroencephalogram (EEG) signals. The characteristics of the Vedic mantras based on the speech signal analysis will also be covered in this talk. The change in EEG rhythm power due to the chanting of Mantras is investigated. The EEG signal has been recorded before and after the chanting of Hare Krishna Mahamantra. Another study has been performed to see the effect of listening to Rudram Mantra. The change in EEG rhythm power shows the manifestation of a relaxed and peaceful state of mind. Instantaneous fundamental frequency (IFF) or pitch detection has a number of applications, such as language recognition, speech recognition, vocal activity recognition, etc. A study has been performed to extract the pitch of four Vedic Mantras. This IFF of chanting from a learned person has been compared to a naïve learner to identify the regions where the chanting needs to be corrected.

Bio:

Ram Bilas Pachori received the B.E. degree with honours in Electronics and Communication Engineering from Rajiv Gandhi Technological University, Bhopal, India, in 2001, the M.Tech. and Ph.D. degrees in Electrical Engineering from IIT Kanpur, India, in 2003 and 2008, respectively.

Before joining the IIT Indore, India, he was a Post-Doctoral Fellow at the Charles Delaunay Institute, University of Technology of Troyes, France (2007-2008) and an Assistant Professor at the Communication Research Center, International Institute of Information Technology, Hyderabad, India (2008-2009). He was an Assistant Professor (2009-2013) and an Associate Professor (2013-2017) at the Department of Electrical Engineering, IIT Indore, where he has been a Professor, since 2017. He is also associated with the Center for Advanced Electronics, IIT Indore. He was a Visiting Professor at the Department of Computer Engineering, Modeling, Electronics and Systems Engineering, University

of Calabria, Rende, Italy, in July 2023; Faculty of Information & Communication Technology, University of Malta, Malta, from June 2023 to July 2023; Neural Dynamics of Visual Cognition Lab, Free University of Berlin, Germany, from July 2022 to September 2022; School of Medicine, Faculty of Health and Medical Sciences, Taylor's University, Malaysia, from 2018 to 2019. Previously, he was a Visiting Scholar at the Intelligent Systems Research Center, Ulster University, Londonderry, UK, in December 2014.

His research interests include signal and image processing, biomedical signal processing, non-stationary signal processing, speech signal processing, brain-computer interface, machine learning, and artificial intelligence and the internet of things in healthcare. He is an Associate Editor of Electronics Letters, IEEE Transactions on Neural Systems and Rehabilitation Engineering, and Biomedical Signal Processing and Control, and an Editor of IETE Technical Review journal. He is a Fellow of IETE, IEI, and IET. He has 317 publications, which include journal articles (194), conference papers (87), books (10), and book chapters (26). He has also eight patents, including one Australian patent (granted) and seven Indian patents (published). His publications have been cited more than 15,000 times with h-index of 66 according to Google Scholar.

Ayurveda: a consciousness based medical science

Dr. Rama Jayasundar

AIIMS, Delhi

Abstract:

There is now an increasing realisation that understanding health and wellbeing requires cognisance of spiritual and existential issues as well. However, the challenge current healthcare faces is in bringing together in one and the same framework the beneficial reductionistic scientific information and the subtler dimensions of the patient as a human being. In this context, it is pertinent to note the biopsychosocial-spiritual framework of ayurveda, which includes consciousness as a part of human existence and spiritual health as an integral component of human wellbeing. Ayurveda, in its true sense, is a consciousness-based medical system. The talk will explore the biopsychosocial-spiritual framework that ayurveda has developed for health and disease management.

Bio:

Prof. Rama Jayasundar is currently Professor and Head, Department of NMR & MRI, All India Institute of Medical Sciences (AIIMS), New Delhi. A PhD in Physics from University of Cambridge, UK, she also holds a professional medical degree in Ayurveda, the Indian traditional medicine.

She has pioneered biomedical MR work in India with her area of expertise ranging from Neuroscience applications of MR, MR spectroscopy, Radiofrequency (RF) coil designing & building, and RF pulse sequence programming. She has wide experience in both experimental and clinical MRI and MR spectroscopy. Her indigenously developed low-cost RF coils for clinical MR scanners costing less than 5% of that of the manufacturer's, had won her the Young Scientist Award. During her stint as a visiting Professor at the Max Planck Institute of Biophysical Chemistry, Gottingen, Germany, she worked on functional MRS techniques. She has a number of research publications, awards and honours to her credit. Her current research interests harness her distinct training in experimental MR, physics, ayurveda and modern medicine for innovative work in ayurveda, its concepts, methods, pharmacology and clinical practices using NMR, MRI and a number of analytical techniques.

Pneuma™: An integrated wearable system for management of SUD

Prof. Ramana Vinjamuri
UMBC, Brain-Computer Interface

Abstract:

Substance Use Disorder (SUD) is a dangerous disease that affects an individual's brain and behavior. This leads to uncontrolled use of illicit drugs, alcohol, excessive use of legal drugs or other addictive behaviors. The prevalence (51.5 million adults with SUD and mental illnesses, Substance Abuse and Mental Health Services Administration (SAMHSA) 2019) and the rate of increase (6% from 2018 to 2019) of SUD in the US deem it a rapidly growing epidemic. Furthermore, during COVID19 pandemic, one of the serious challenges faced by the American Society of Addiction Medicine (ASAM) is the treatment of homeless individuals with SUD because of their compromised immune systems. The National Institute on Drug Abuse (NIDA) estimates that the total expenditure of drug-related complications exceeds 500 billion dollars when healthcare costs and job losses are considered. Despite this growing epidemic and its subsequent consequences, there are limited management and treatment options, pharmacotherapies, and psychosocial treatments available for SUD. To this end, there is a need for new and improved treatments and management of SUD as emphasized in the strategic plan of the NIDA. The goal of our multidisciplinary team is to develop "Pneuma™", an integrated portable neurotechnology that is capable of management of SUD using wearable biosensors, including electrodermal activity (EDA) and electroencephalography (EEG) sensors. The system detects and modulates stress, a key trigger in substance abuse. This system will have four major components – (1) Based on well documented negative effects of stress in SUD, detection of stress and emotional states recorded using EEG and EDA sensors (2) Machine-learning (ML) and artificial intelligence (AI) algorithms for improving the detection of stress, emotion and behavior (3) Neurofeedback using EEG sensors to measure, manage and modify brain activity and thus, associated behavior and (4) A smartphone App that can provide a user-friendly and personalized graphical user interface for the neurofeedback. The proposed technology with its unique ability to influence the brain and the behavior will impact the individuals with this serious epidemic in a most immediate and personal manner. Substance Use Disorder (SUD) is a dangerous disease that affects an individual's brain and behavior. This leads to uncontrolled use of illicit drugs, alcohol, excessive use of legal drugs or other addictive behaviors. The prevalence (51.5 million adults with SUD and mental illnesses, Substance Abuse and Mental Health Services Administration (SAMHSA) 2019) and the rate of increase (6% from 2018 to 2019) of SUD in the US deem it a rapidly growing epidemic. Furthermore, during COVID19 pandemic,

one of the serious challenges faced by the American Society of Addiction Medicine (ASAM) is the treatment of homeless individuals with SUD because of their compromised immune systems. The National Institute on Drug Abuse (NIDA) estimates that the total expenditure of drug-related complications exceeds 500 billion dollars when healthcare costs and job losses are considered. Despite this growing epidemic and its subsequent consequences, there are limited management and treatment options, pharmacotherapies, and psychosocial treatments available for SUD. To this end, there is a need for new and improved treatments and management of SUD as emphasized in the strategic plan of the NIDA. The goal of our multidisciplinary team is to develop “Pneuma™”, an integrated portable neurotechnology that is capable of management of SUD using wearable biosensors, including electrodermal activity (EDA) and electroencephalography (EEG) sensors. The system detects and modulates stress, a key trigger in substance abuse. This system will have four major components – (1) Based on well documented negative effects of stress in SUD, detection of stress and emotional states recorded using EEG and EDA sensors (2) Machine-learning (ML) and artificial intelligence (AI) algorithms for improving the detection of stress, emotion and behavior (3) Neurofeedback using EEG sensors to measure, manage and modify brain activity and thus, associated behavior and (4) A smartphone App that can provide a user-friendly and personalized graphical user interface for the neurofeedback. The proposed technology with its unique ability to influence the brain and the behavior will impact the individuals with this serious epidemic in a most immediate and personal manner.

Bio:

Ramana Vinjamuri, PhD is an Associate Professor in the Department of Computer Science and Electrical Engineering (CSEE) at UMBC. He is the Director of Sensorimotor Control Laboratory or Vinjamuri Lab that houses 4 PhD students, 6 MS students and 6 UG students. He received his PhD in 2008 and a postdoc (2008-2012) in the field of Brain Computer Interfaces (BCI) from the University of Pittsburgh. He received the Mary E Switzer Merit Fellowship from NIDILRR in 2010. He received the NSF CAREER Award in 2019. He received a supplement to this award in 2022 to explore commercialization and collaboration of resultant technologies in global markets in Southeast Asia. He received the NSF Industry University Cooperative Research Center (IUCRC) Planning grant in 2020. He is well connected with industry in BCI and is in the process of establishing a neurotechnology center called BRAIN at UMBC. To this end, he held a successful BRAIN industry planning meeting in Sep 2022. This improved the industry network and potential commercial partners for Pneuma™. In June 2022 the PI received an SBIR award from NIDILRR to partner with Delsys, Inc on another technology that started as a publication in Vinjamuri Lab strengthening relations with this potential commercial partner. His other notable commercialization and innovation grants are from the United States India

Science and Technology Endowment Fund (USISTEF) and the New Jersey Health Foundation (NJHF). His team has developed and tested a benchtop prototype system that can record EEG and EDA activity under simulated stress and no stress conditions. In July 2022, the PI (Vinjamuri) was invited as a visiting scientist at NIDA collaborating on ecological momentary assessment (EMA) to improve stress detection. In December 2022, the PI was recognized as a Technologist in the 2023 Maryland New Venture Fellowship program (similar to I-Corps node program). He worked with business analysts and mentors to conduct preliminary market analysis and customer discovery in Spring 2023, prior to winning the pitch competition in May 2023 at the conclusion of the fellowship.

Yoga and Psychiatric Disorders: Insights from NIMHANS

Dr. Shivarama Varambally

NIMHANS

Abstract:

Yoga as a lifestyle has existed in India for millennia. Although originally designed to facilitate spiritual progress of an individual, there is now convincing data from all over the world that yoga as a practice has salutary effects on both physical and mental health, and that yoga-based interventions have efficacy in several physical as well as mental disorders. Research on yoga at NIMHANS has a history of more than 50 years, with initial work in Neurophysiology and Clinical Psychology focused on effects in long-term practitioners and healthy subjects. In the new millennium (2007 onwards), yoga has been offered as a clinical service to patients with psychiatric and neurological disorders with promising results. In 2014, NIMHANS established the NIMHANS Integrated Centre for Yoga and in 2019, this was integrated into the newly established Department of Integrative Medicine.

Work at the NIMHANS Integrated Centre for Yoga has focused on 2 main areas – designing and development of generic yoga modules for specific neuropsychiatric disorders; and evidence generation for the efficacy and mechanisms of action of yoga as an intervention in these disorders. Of particular note is the demonstration that yoga is efficacious as a therapy in the major mental disorders Depression and Schizophrenia as well as preliminary evidence for yoga as a therapy in cognitive disorders of the elderly, attention deficit hyperactivity disorder in children, and obsessive-compulsive disorder among others. These studies have also thrown light on some of the brain mechanisms underlying these effects such as reduction in stress markers, improvement in markers of neuroplasticity, modulation of neurohormones and brain metabolism. The talk will focus on summarizing the work done at NIMHANS on yoga as an intervention for major psychiatric disorders and insights on effects and mechanisms of yoga from these studies.

Bio:

Professor of Psychiatry and Founder Head, Department of Integrative Medicine National Institute of Mental Health and Neurosciences, Bengaluru India

Rise Of AI/ML and Future Biomed Technologies in Stroke

Dr. Shyam Jaiswal

CARE Hospitals, Neurology

Abstract:

Needs, Challenges and Opportunities. What is stroke and its impact? What are the needs, challenges and opportunities? Rise of AI/ML in Neurotechnology. Future Biomedical Technologies in Stroke. Rise Of AI/ML and Future Biomed Technologies in Stroke

Bio:

As a distinguished Consultant Neurologist and Strokologist, this professional is currently the Co-Director of the Stroke Program at the CARE Institute of Neurological Sciences in Banjara Hills, Hyderabad. With expertise in areas such as Stroke IVT and MT, Epilepsy Surgery, Invasive EEG-SEEG, and Functional language mapping, their academic journey includes an MBBS from GSMC & KEMH, Mumbai, and DNB in Neurology from CARE Hospital, Hyderabad. Holding an MD in Internal Medicine from VMMC, Solapur, and recognized as a DNB teacher & Co-guide at CARE Hospital, they are affiliated with prestigious medical organizations globally. Their achievements encompass 12 international travel grants, 2 international observership prizes, 18 international presentations, and 21 national presentations, along with a notable contribution of 12 international publications. A member of various neurology associations, including IES, IEA, ILAE, AAN, IAN, TNSA, MDS, MDSI, WSO, and IHS, this professional's dedication and contributions underscore their commitment to advancing neurological sciences.

Ayurveda

Dr. Subash Singh

Abstract:

"अस्मिन् शास्त्रे पंचमहाभूतशरीरिसमवायः पुरुष इत्युच्यते । सु० सू० अ० 1/30 As per the Science of Ayurveda, Shareer (purush) is composed of Panchmahabhoota (space, air, fire, water, prithvi) and Aatma. This is nourished by the blood. Therefore, wise men should protect blood from food, drink, their conduct and intellect. Allergic conditions, autoimmune disorders, asthma, diabetes, cardiac diseases, obesity, hypertension, thyroid, arthritis, infertility, disc bulge, osteoporosis, lipidosi, tumors, cerebral insufficiency, dementia have been the common problems of world now a days. These all are linked to our diet, life style and conducts directly. In the recent past the whole world faced difficulties from the pandemic of covid-19 where medical science failed to get cure of the disease. Studies conducted at various levels reported that Ayurvedic medicines have been successful in the treatment of these disorders The theme behind this 2 and half hours special session of MBCC-2023, IIT Mandi realizes to establish a 500 bedded patient care hospital and research institute in Ayurveda for the welfare of their employees as well as for the people of this region. This conference will provide a scientific platform to discuss the issues between the experts of allopathy Ayurveda, Yoga and Naturopathy and Physiotherapy systems of medicine. The suggestions came out of the discussion will be noted and implemented for further development. I hope, this conference will be very much successful and proved to be a mile stone in the field of Ayurveda.

Bio:

Dr. Subhash Singh is a Former Director of Central Council for Research in Ayurvedic Sciences(CCRAS), Ministry of AYUSH, New Delhi(Govt. of India). He is involved in academic, clinical and research activities in Ayurved for last 35 years in various capacities. He received his BAMS degree from University of Bihar, Muzaffarpur and MD in Shareer Rachna from Govt. Ayurvedic College, Lucknow. He has 4 monographs to his credit and has also contributed a chapter on Sciatica in an international book titled "Scientific basic of Ayurvedic Therapies" published by CRC Press, Florida. He has published over 30 Scientific/Research papers in various National and International peer reviewed journals and has served in over 50 ayurved research projects. He has facilitated 3 MoUs for CCRAS with BITS(Pilani), Punjabi University(Patiala) and Bhagwan Mahaveer Cancer Hospital and Research Center for clinical trials in Ayurved and drug development studies. Dr. Singh is Member and Ayurved expert in various national and international universities, institutes and organizations. He has supervised preparation of more than 500 single/compound herbal, herbo mineral and herbo metallic

formulations for APIs. His research work on the treatment of Aplastic Anemia patients following Ayurved is unparalleled across all systems of medicine. Till date, he has successfully treated more than 100 patients suffering from Aplastic Anemia through out the world, with a success rate of 85 percent. Published case studies and reports in leading Journals.

Dr. Singh has been a member of Board of Studies in Ayurved, Punjab University, Chandigarh. Secretary of CCRAS Scientific Advisory Committee and Rajasthan Ayurved Vigyan Parishad. Member/Secretary in various institutes under CCRAS. He has received numerous awards and accolades for his distinguished contribution in the field of Ayurved.

Yoga and cardiorespiratory regulation

Dr. Kaviraja Udupa

NIMHANS

Abstract:

Yogis prepare the body and mind to attain higher levels of consciousness by controlling the autonomic nervous system (ANS) and tend to use the respiratory system, which being semi-voluntary in nature acts as the key to attaining this voluntary control over the ANS. Heart Rate Variability (HRV), which computes the instantaneous changes in heart rate over time, is a good measure of cardiac autonomic balance. It is imperative to have respiration under normal pattern (12-15 breaths/min taking 5-6 seconds for each respiratory cycle) to compute Sympatho-Vagal Balance (SVB) which measures the neuro-cardiac control through these two limbs of ANS. In this review, we summarize several research studies undertaken at NIMHANS and other institutions demonstrating modulation of sympathovagal balance through the practice of pranayama, based on the frequencies of breathing (slow vs fast), patterns of breathing, special breathing techniques in healthy subjects as well as in various neurological and psychiatric conditions. Further, we also discuss specific nostril breathing using HRV measures, to demonstrate how Surya (right) and Chandra (left) Nadi control the two limbs of ANS, thus attaining ideal SVB. In addition to the modulation of autonomic functions, other possible mechanisms will also be discussed based on other parameters employed in these studies such as neurophysiological measures, imaging, serum levels of neurotropic factors, neurohormone, and other biochemical variables. In summary, the presentation aims to demonstrate how yoga, especially pranayama, achieves SVB, samatvam (equanimity or balance) of ANS will be demonstrated using various neurophysiological experiments in healthy subjects as well as in patients with various neurological and psychiatric disorders.

Bio:

With a robust educational background encompassing MBBS from Mysore University, MD in Physiology from JIPMER, Pondicherry, and a PhD in Neurophysiology from NIMHANS, Bangalore, this accomplished professional further honed expertise through a Post-Doctoral Fellowship in Clinical Neurophysiology at the University of Toronto, Canada. Currently serving as a Professor at the Department of Neurophysiology in NIMHANS, Bangalore, their prolific research career is underscored by over 136 peer-reviewed publications, including 20 book chapters and 100 abstracts. Noteworthy research contributions include securing six extramural research grants as Principal Investigator, 12 as a

co-investigator, and receiving four fellowship grants and over 10 travel grants. The professional has been recognized with seven academic competitive awards and has delivered over 95 invited scientific lectures in India, Canada, and the US. Their research interests span the neurobiology of mood and movement disorders, stress coping mechanisms, integration of Indian systems of medicine, autonomic nervous system evaluation, and exploration of biomarkers in neurological and psychiatric disorders. Additionally, they delve into human ethics, spirituality (Sanatan Adhyatma), and consciousness research while actively guiding and supervising numerous PhDs, Post-Docs, MDs, and MPhil candidates.

Bhagavata Sakhya model of consciousness. Correlation with modern scientific views and its practical applications.

Dr. Vadim Tuneev

BIHS Florida

Abstract:

In this presentation we briefly explore the model of consciousness presented in the “Bhagavata Purana”, compare this model with the classical Sanhya-Yoga model and show how it roughly corresponds with the modern views of the structure of human brain. We will show how this model explains both ordinary and extra-ordinary mechanisms of cognition, and how by using this model a wide spectrum of psychological techniques can be explained and new techniques be developed. This model also allows to develop conceptual framework of how to approach the treatment of degenerative diseases, like Alzheimer's disease. We will also show how the use of this model can provide grounds for the further research in science

Bio:

DR. VADIM TUNEEV, aka Bhakti Vijnana Goswami Graduated with distinction, Moscow State University, 1978 Ph.D., Institute for Molecular Biology, Russian Academy of Sciences, 1986 (Thesis: The Structure of Nucleosomes: Sequencing Histone Molecules on the DNA) In 1980 started deeply studying Bhagavad-gita and other literatures of antient India living in different ashramas in India and abroad, and translating antient scriptures into Russian. Took part in The First International Conference on the Study of Consciousness Within Science (1990, San-Francisco). Studies Sanskrit and the six systems of Indian philosophy. Since the beginning of 90-s widely travels and gives lectures and seminars in different parts of the world on various topics concerning Indian scriptures in the light of the modern science. In 2010, the Public Awards Council of the Russian Federation awarded him the 3rd degree medal for Professionalism and Business Reception in recognition of strengthening Russian-Indian ties and for his contribution to the popularization of the spiritual and literary heritage of India. Scientific Advisor, BIHS Florida & GBC Emeritus, ISKCON

Special Session

Papers/Abstracts

Dialysis free with grad – a case study

Dr Biswaroop Roy Chowdury¹

¹Founder-Director HIIMS Hospitals

Abstract:

The global prevalence of chronic kidney disease (CKD) is nearly 70 crores, with nearly 1/3rd of the patients belonging to either India or China. Chronic Kidney disease (CKD) is a progressive, irreversible decline in renal function that occurs over time. The only symptom is a metabolic anomaly at first. When the glomerular filtration rate (GFR) falls below 30 ml/min, CKD is evaluated. The traditional management method comprises dialysis and kidney transplant.

The objective of the case study was to determine the effectiveness of the GRAD System (Gravitational Resistance and Diet) including gravity (Head Down Tilt), heat (Hot water Immersion) and plant-based diet for minimizing the need for dialysis and avoiding or delaying kidney transplantation in Chronic Kidney Disease Patient. GRAD system effectively eliminated any further need for dialysis. Upon regular follow ups it was found that the patient has been dialysis free for the past 1 year 5 months (May 2022 to 28 Sep 2023). No discomforts were reported.

Keywords: CKD, GRAD, Hot water immersion, Head down tilt, Creatinine, Urea, Bath tub, Kidney disease

Introduction

Chronic Kidney Disease (CKD) is a lasting condition all over the globe. When Kidneys don't work as they should CKD progresses. It's a common condition associated with getting older. Moreover, the person on allopathic medications of hypertension, their kidneys are damaged in the long run. So mostly people on allopathic drugs develop CKD and finally turn into dialysis patients due to side effects and the over medications showing the effects on the kidneys¹. The economic as well as the social life of the relatives of the patients is also affecting. The cost of living of the dialysis patients is higher². Until now, there had been no known intervention scientifically proven to help severe CKD patients to reverse the disease and free themselves of their dependency on dialysis, transplant and drugs. However, in the modern scientific literature, there are references of Head Down Tilt (HDT) and Hot Water Immersion (HWI) which are known to activate the kidney. These techniques can also effectively excrete Sodium by five times, Potassium by three times, increase the urine volume by three times and result in the overall reduction of body weight and swelling³. Even in Ayurveda, there are several references of HWI referred to as *Avagaha SWED*⁴ as an effective method to rejuvenate the compromised kidneys.

Need for the Study

Chronic Kidney disease (CKD) is a progressive, irreversible decline in renal function that occurs over time. The only symptom is a metabolic anomaly at first. When the glomerular filtration rate (GFR) falls below 30 ml/min, CKD is evaluated. The traditional management method comprises dialysis and kidney transplantation, both of which are out of reach for the Indian populace due to financial constraints. As a result, research into a safe and alternative therapy that can assist reduce the need for dialysis and delay or stop the need for kidney transplantation is required.

An average kidney transplant costs Rs 2,00,000 in a government hospital and Rs 7,00,000 to 10,00,000 in a private facility. In addition, the annual medicine maintenance cost after the transplant is Rs 2,00,000 per year or Rs 20,000 per month. As a result, the social and economic ramifications of CKD are significant, and the traditional therapeutic method comprises dialysis and kidney transplantation, both of which are unaffordable and unacceptable to the Indian people. Research into a safe and alternative therapy that can assist reduce the need for dialysis and delay the need for kidney transplantation is critical. Several institutes and academics are attempting to make progress in this approach.

GRAD Protocol combines HDT, HWI and the DIP diet, with the goal to reverse kidney failure, especially among the patients who are dialysis dependent.

Objectives and Goals of the Study.

- To demonstrate the effectiveness of the combination of various techniques including gravity, heat and plant-based diet in the treatment of CKD.
- To provide a future therapeutic option for a large human population suffering from CKD, with the goal of minimizing the need for dialysis and avoiding or delaying kidney transplantation.

Methods and Techniques.

2 hours of HDT + 2 hours of HWI + DIP Diet = GRAD System.

As part of the GRAD system, she was encouraged to do 2 hours of HDT and HWI every day along with following the DIP Diet. Every day for the purpose of monitoring her P R A N (Patients Reporting to Activate Nephrons) sheet was maintained for patients through the GRAD app. In the PRAN sheet following parameters are being monitored.

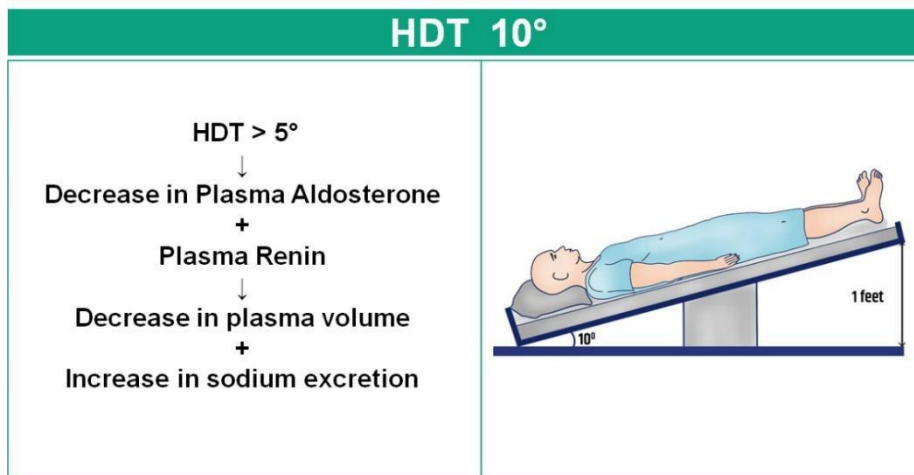
1 Weekly P R A N Sheet (For Kidney / Liver Patients)

Arrow represents the expected outcome of the patients on GRAD system

Weekly P R A N Sheet (For Kidney / Liver Patients)						
Arrow represents the expected outcome of the patients on GRAD system						
Date	B.P.	Pulse	Weight	Swelling (yes/no)	Urine Output (If <400 ML)	Symptoms
1	HDT	HDT	HWI	HDT		
	1.	1.	1.	1.		
	2.	2.	2.	2.		
	HWI	HWI	HWI	HWI		
	3.	3.	3.	3.		
	4.	4.	4.	4.		

Based on the improvement on the above parameters, the patient was required to taper down or phase out the drugs and various other medications which she was taking and to reduce the frequency of dialysis. She was advised to gradually increase the duration of HDT / HWI as the body adapted to the therapies and started showing positive improvement.

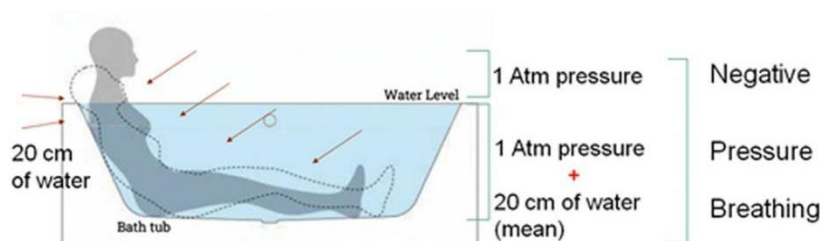
2 What is Head Down Tilt (HDT)



When a patient is made to lie down at 10 degrees angle of the head, it leads to a decrease in the Plasma Aldosterone and Renin hormones in the body. This results in a decrease in Plasma volume and subsequently, an increased sodium excretion from the body.

3 What is Hot Water Immersion HWI

3.1 The Physics of HWI (Lungs)⁵



When a patient is made to sit in the bathtub with water level up to the neck, the air pressure above the neck is 1 Atmosphere. Below the neck the atmospheric pressure is 1 Atmosphere. If the mean height of

the water in the bathtub is 20 cm, the pressure below the neck increases by about 2% (1 atm + 20 cm). Therefore, when a patient sits in neck deep water, his body undergoes two different pressures, one above the neck and one below the neck. This difference in pressure results in negative pressure breathing.

As a result of this breathing, a 20% increase in the stroke volume of the heart is observed. The heart pumps an increased volume of blood by 20% due to the negative pressure breathing. This increased blood pumping leads to redistribution of blood from the lower portion of the body to the upper torso, waist upwards. When this is coupled with the heat of 400 C, i.e. the combination of water pressure and temperature, our skin becomes the third kidney, expelling all the waste from our body in the form of perspiration and detoxification.

3.2 Chemistry of HWI⁶

As shown in image-11, the movement of the blood from being centered on the kidney upwards results in certain chemical changes in the body. The levels of IL-6, Ilira, Hsp72, 1Hsp72, and NO increase in the body whereas the levels of Norepinephrine, Vasopressin, and Renin decrease in the body within two hours of immersion of the body in the bathtub.

Chemistry of HWI



↑ IL-6, Ilira	↓ Norepinephrine
Hsp72 , iHsp72	Vasopressin
NO	↓ Renin

4 What is D.I.P. Diet

The D.I.P. (Disciplined and Intelligent diet) through clinical trials by the Ministry of Ayush in India Health Ministry of Nepal¹², 12A and various case studies⁷ in India and Malaysia¹³, 13A, has been proven to be effective in reversing lifestyle diseases.

Steps to Design Your Personalized D.I.P. Diet:

Till 12:00 noon, eat only fruits of three to four types including mango, banana, grapes, etc.

Minimum amount to be consumed = Your body weight in kg × 10 = gm

For example, a 70 kg person should consume at least 700 gm of 4 types of fruits before noon.

Always eat your lunch/dinner on two plates. Plate 1 and Plate 2.

Plate 1 should consist of four types of vegetables like carrot, tomato, radish and cucumber etc. in raw form. Minimum amount in Plate 1 = Your body weight in kg × 5 = gm.

For example, a 70 kg person should eat at least 350 gm of four types of raw vegetables. Plate 2 should consist of home cooked vegetarian food with negligible salt and oil. (Replace wheat & rice with millets)

First finish eating from plate 1 in accordance with the above calculation, then take from plate 2 as much as you want. The rules for lunch and dinner are the same; however, you must remember to finish dinner by 7:00 P.M.

To Avoid	Snacking / Binge eating
1. Packed food	1. Soaked nuts: Your wt (kg) = gm (e.g. 70 kg person can consume 70 gm of nuts in a day)
2. Refined food	2. Fruits: Plenty
3. Dairy food/Animal foods	3. Coconut water: As you like
4. Nutritional supplements	4. Sprouts: Your Wt.(kg) = gm
5. Avoid drinking tea/coffee specially before lunch	5. Coconut: As you like
6. Never eat after 8:00 P.M.	6. Sunshine: 45 min
7. NSAIDs	

5 Case Study

Laxmi, age 26 years/female, was diagnosed with Acute cortical necrosis CKD in April 2022. Just before the diagnosis she had miscarriage due to low Hemoglobin (4.9). She also developed swelling in legs & body which led to blood tests & was found with raised KFT parameters (s. creatinine = 21.32, urea = 256.90). Patient was 1st admitted to Maharana Bhopati Hospital in Udaipur. On 16th April first dialysis was carried out. After 3 dialysis in 8 days, on 1st May 2022, the patient was transferred to RR hospital (Army) in Delhi. In the hospital, 7 dialysis were done within 1 month. She also underwent a kidney biopsy on 04 May 22. Kidney biopsy revealed diffuse cortical necrosis. Her last dialysis was done on 29th May 2022 and after that she took admission in HIIMS hospital and started GRAD Therapy.

5.1 GRAD Protocols that were followed are as below

1. Punarva leaves decoction or Pathar-chatta decoction of Coriander leaves decoction twice a day alternating them.
2. She was asked to chew 2 gm raw ginger and 2 gm raw turmeric empty stomach before every meal with some lukewarm water.

Breakfast.

She was advised to take 450- 550 gm of fruits 3-4 types of seasonal and fresh fruits of her choice

Mid-morning.

Green juice including green leaves was advised to take at least 150 ml everyday

Lunch: Plate 1 + Plate 2.

Plate 1: Raw vegetables (350 gm) like, cucumber, broccoli, Tomato, carrot, radish etc

Plate 2: Cooked food prepared in zero oil, negligible salt in earthen pot

Millets in fermented form like foxtail, browntop, little millet, kodo, barnyard (organic) in form of ambali or chapati or khichdi instead of wheat or rice

Evening.

Red Juice: Beetroot+ carrot Or Beetroot + tomato- 150 ml

Dinner: Plate 1 + Plate 2.

Plate 1: Raw vegetables -300 gm (any fresh and seasonal vegetables of her choice)

Plate 2: Millets or Vegetable soup- 200ml

Snacks: In between meals if feels hungry.

sprouts, vegetable juice, fruits, coconut milk, soaked nuts, vegetables

Important guidelines advised:

To Follow the diet plan 100 % religiously

To consume food & drinks very slowly like hot tea

She was also asked to avoid animal-based food like meat and dairy products like milk, butter, curd, paneer. Stop the consumption of tea

Finish dinner by 7 pm maximum

GRAD THERAPY Routine.

She was advised Hot water Immersion therapy (HWI) and Head Down Tilt therapy each for 2 hours

Additional therapies advised to be followed at home are

Grounding- walking or sitting or lying down barefoot on the grass, mud, pebbles in the park

Physical activities like deep breathing

Sun gazing and sitting under sun during sunrise for one hour everyday

Below are tabulated her parameters before starting GRAD Therapy and present status during follow-up.

	Before Starting GRAD Therapy (29 th May 2023)	At the time of writing this article (as on 31 Oct. 23)
Medical condition	Dialysis Dependent CKD Patient	Dialysis Free
Medications Taken	Cap Autrin-bd, sodium bi carbonate 500, Shelcal, Sevelamer 800mg, Dytor, Pantoprazole	100% GRAD Therapy (HWI + HDT) 60% DIP Diet, sevelamer 400 mg, Nephron plus.
Physical Discomforts/ symptoms	swelling in legs & body indigestion, vomiting, itching anxiety	Nil
Frequency of Dialysis	02 per week	Dialysis Free for past 1 year and 5 months
Investigation	KFT creatinine -21, Urea 268	Creatinine -3.74, Urea 65.86

6 Discussion:

This is a case study to assess the benefit of the GRAD system in reversing CKD among the dialysis patients. The GRAD system is an unusual amalgamation of the knowledge of engineering in terms of application of gravitational force and hydrostatic pressure on the human body and the modern medical science for finding a cure for CKD patients. GRAD combines physics of the surroundings with chemistry of the human body to activate the dying kidney. As evident from the case study the CKD patients can successfully lower the burden of the disease partially/fully and have the potential to revolutionize the way lifestyle illness are treated. The best part about the GRAD system: it can be followed safely and with minimum resources at the convenience of your home and even in the rural setting. Study on larger group of patients for longer duration should be carried out to see the long-term effect of the GRAD System.

7 Conclusion:

GRAD system can be recommended as an effective method to reverse CKD among mild, moderate and severe CKD patients and can be seen as an effective alternative to dialysis and kidney transplant. In this case study Laxmi was able to avoid future dialysis and a potential renal transplant. Her present status at the time of writing this article was creatinine 3.37, urea 65.86 and dialysis free.

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7. Reversal of Type 1 Diabetes Using Plant Based Diet: A Case Study. Journal of the Science of Healing Outcomes ISSN 2347-8438

Prospective cohort study effectiveness of gravitational resistance and diet (GRAD) system in reversing chronic kidney disease (CKD) – Among dialysis patients

Awadhesh Pandey¹, Amar Singh Azad², Anu Bhardwaj², Gagan Thakur²,

Gayathri M. Prakash²

¹Department of Medical Sciences, Shridhar University, Pilani, India;

²Department of Medical Sciences, Dayanand Ayurvedic College, Jalandhar, India

Abstract:

Background:

The global prevalence of chronic kidney disease (CKD) referred to as mutraghat/ mutrakshay in Ayurveda is nearly 70 crores with nearly 1/3rd of the patients belonging to either India or China. There has been no lasting and effective cure till now, and the only available treatments are either Dialysis or Kidney transplants.

Objective:

The objective of the Study was to determine the effectiveness of the GRAD System developed by Dr. Biswaroop Roy Chowdhury in reversing CKD among patients who are dependent on Dialysis.

Methods: This was a prospective cohort study conducted from August 2021 to March 2022. 100 dialysis patients, who agreed to adopt the GRAD system in their lifestyle for an average of 100 days were closely monitored.

Results:

28 out of 100 dialysis patients fully adopted the GRAD system. Among them, 21 (75%) were completely free of dialysis and supporting drugs while the remaining 25% were partially free of dialysis and supporting drugs. 72 patients partially adopted the GRAD system. Among them, 11 (15%) were able to be free of all the supporting drugs while 44 could reduce the frequency of dialysis Conclusion: There was no serious negative impact seen and no death or adverse event was reported as a result of the adherence to the GRAD System. All the patients experienced a marked improvement in their health, spirits and financial well-being.

To Evaluate the Efficacy of Agnikarma and Disciplined and Intelligent Person Diet in Katigata-Sandhivata w.s.r to Lumbar Spondylosis – A Case Report.

Dr. Monika Sode¹, Dr. Rahul Sherkhane² Dr. V. D. Mahanta³, Dr. S. K. Gupta⁴

¹Medical officer, Shalya Tantra Department, All India Institute of Ayurveda

²Assistant Professor, Shalya Tantra Department, All India Institute of Ayurveda.

³Associate Professor, Shalya Tantra Department, All India Institute of Ayurveda.

⁴Head of Department, Shalya Tantra Department, All India Institute of Ayurveda.

Abstract:

Background: Lumbar Spondylosis is a degenerative condition which affects the lower spine. The Spine is compromised by a narrowing of the space between the vertebrae associated with growth of bone spurs (osteophytes). It is characterized by progressive loss of function and painful lumbar joint movements. Low back pain affects approximately 60–85% of adults during some point in their lives and it is responsible for about 10% of all the back pain conditions.

Objective: The present case report was conducted to evaluate the efficacy of Agnikarma and DIP diet in lumbar spondylosis pain by balancing local Vata and Kapha Dosha without any untoward effects within time constrain (30 days). Case presentation- A 51-year-old female patient visited Shalya OPD with complaints of severe pain, stiffness and difficulty in forward and backward bending movement in lumbar spine for 2 years. She was diagnosed as a case of lumbar spondylosis. The patient was treated with Agnikarma and DIP diet.

Result: The patient showed significant ($p < 0.001$) improvement in lower back pain and thyroid stimulating hormone from 4.88 uIU/mL to 1.94 uIU/mL within time constraint (3 month). A significant response in various symptoms such as Pain, stiffness, forward and backward movement of the lumbar spine was found.

Conclusion: This case report highlights the potential of Ayurvedic management in lumbar spondylosis and provides the better pathway for this disease.

Keywords: KatigataSandhivata, Lumbar Spondylosis, Agnikarma, DIP Diet

1. Introduction

Lumbar Spondylosis is a degenerative condition which affects the discs, vertebral bodies of the lower spine associated with growth of bone spurs (osteophytes) or bony bridges around a degenerating intervertebral disc in the lumbar vertebrae. In a patient with Lumbar Spondylosis, the spine is compromised by a narrowing of the space between the vertebrae, causing a variety of health problems ranging from back pain to neurological issues. Low back pain (LBP) affects approximately 60–85% of

adults during some point in their lives. Lumbar Spondylosis is responsible for about 10% of all the back pain condition¹ This condition can be correlated with KatigatSandhiVata Till date only symptomatic treatments are available like use of anti-inflammatory analgesic drugs, steroids injections, physiotherapy, exercise etc. But none of these provide satisfactory result. Long term use of anti-inflammatory, analgesic drugs and steroids injection are prone to adverse effects. In Ayurveda Snehana, Upanaha, Agnikarma, Raktamokshana, Katibasti, Virechana, BhesajaChikitsa etc. have been recommended for management of Vatik disorders.^{2,3} Among these Agnikarma is a well-known para-surgical procedure and has its own therapeutic value for treatment of Sandhigata Vata(Lumbar spondylosis).⁴ Acharya Sushruta has mentioned Agnikarma procedure as a best among all other procedures ^{5,6} (su.su 12/3) and in this study Pancha Dhatu Shalaka has been selected for Agnikarma.⁷It is suitable for heat transfer and to produce Samyak Dagdha Vrana (ideal therapeutic burn). A single case study of lumbar spondylosis is reported here in which vitiated vata dosha was pacified with - 4 sessions of Agnikarma with Bindu Dahan Vishesha by Pancha Dhatushalaka at the interval of 7 days along with DIP (disciplined and intelligent person's) diet⁸ for a period of one month. After one month, the patient got relief from pain, stiffness, and restricted movement in the lumbar spine.

1.1 Case Presentation

A 51 year middle-aged female patient was brought by her husband to Shalya Tantra OPD of All India institute of Ayurveda. Presenting with complaints of shola (severe pain), stambha (stiffness) and difficulty in forward and backward bending movement in lumbar spine for 2 years. History of present illness, according to the patient, she was asymptomatic for last 3 year and then she noticed severe pain in her back and difficulty in walking, for this she took allopathic treatment from private hospital, but did not get any relief) She had a history of hypothyroidism last for last 4 years and for this she was on thyroid supplement (tablet thyronorm 50 mcg once in morning, empty stomach).

1.2 Investigations

Hb- 11.8 gm/dl, CRP and RA - Negative and other hematological parameters were normal, renal parameters, blood sugar and urine investigation also within normal limits. On systemic examination League's test was positive on the right leg as seen in table 1. Diagnosis has been done on the basis of- X-ray of lumbar spine (AP & Lateral view) shows degenerative changes in the lumbar spine in the form of marginal osteophytes formation.

After taking written informed consent and careful assessment (table 2), patient was treated with - 4 sessions of Agnikarma with Bindu Dahan Vishesha by Pancha Dhatu Shalaka at the interval of 7 days for 1 month and followed by DIP diet for 3 months (image 1,2,3,4,5).With this short duration of

treatment protocol, patient got relief from pain and stiffness without any untoward effect. During this diet the patient has not to consume any animal-based product including milk products and packaged food manufactured by any industry. All food was pure vegetarian (plant based).



Fig. 1. Instrument tray



Fig. 2.Mark the tender points



Fig. 3. Agnikarma with PanchdhatuShlaka



Fig. 4. Apply aloe vera over

burn mark



Fig. 5.Dusting of *Haridra* powder

Table 1. General Examination

General examination	Systemic examination
Appetite-normal Bowel regular Bladder-normal Sleep-normal Temperature-normal Pallor,Icterus,Clubbing, Lymphadenopathy-absent Blood pressure-130/86mmHg Pulse-88 beats per minute. Tongue-clear	Cardiovascular system-NAD Respiratory system-B/L chest clear no added sound. Gastrointestinal system-NAD Locomotor system- difficulty in walking, limping gait. Straight leg raising test- positive in right legs at 20° and left leg at 50 °. League's test was positive on the right leg. Power in the right lower limb was lesser than the left side. Central nervous system- Higher mental function: normal Motor function-normal Cranial nerves normal

Treatment Given

Table 2. Procedure of *Agnikarma*

Purva karma	Pradhana karma	Paschat karma
Written informed	Bindu Dahan	Dusting with Haridra

Consent was taken from the patient Information sheet was provided to patient at the time of enrolment. Snigdha Picchilaannapana sevana in form khichdi Preparation of triphala kashaya, kumari patra majja Pancha dhatu shalaka was heated up to red hot. Preparation of local part: local part was washed with triphala kashaya and wiped up with dry sterilized gauze and that area was covered With a cut sheet.	Vishesawas done with help of pancha dhatu shalaka at most painful and tender area of lumbar joints. 5 mm gap was left between two points of dagdha vana and care was taken to produce samyak dagdha vana. During agnikarma crushed, ghrita kumara majja was applied to relieve burning sensation.	Churna was done over the site after agnikarma Patient was advised to avoid water contact at least 24 hours. Antiseptic dressing with shatadhuataghrita was advised till complete healing of burnt wound.
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Discussion

In ayurveda Katigatasandhivata is a disease described under Vatavyadhi and it resembles lumbar spondylosis in respect to etiology, pathology, and clinical features. In this article a case is discussed which is a known case of lumbar spondylosis. Based on the clinical presentation the patient was treated on the line of management of KatigataSandhivata and the treatment was planned accordingly

Breakfast.

In morning patient was advised to take seasonal fruits(10% of body weight) before his/her breakfast.

Lunch.

In afternoon patient was advised to take seasonal salad (10% of body weight) before his/her

Table 3.DIP diet

As per the dosha-dushya involvement and the physical condition of the patient, it was decided to treat Agnikarma along with the DIP diet. Acharya Sushruta has indicated Agnikarma, when severe pain occurs in Twak, Mamsa, Sira, Snay

Sandhi, and Asthi due to Vata Prakopa and Vata vitiated in Sandhi is the main pathogenesis of KatigataSandhivata. Till date only symptomatic treatments are available like use of anti-inflammatory analgesic drugs, steroids injection, physiotherapy, exercise etc. But none of these provide satisfactory results. Agnikarma (therapeutic heat burn) is one of the procedures which gives instant relief from pain by balancing local Vata and Kapha Dosha without any untoward effects. It has long term pain relief without any side-effect. It is OPD based procedure (no hospitalization required) and well – tolerated by patients, and cost –effective as well. In lumbar spondylosis, atherosclerosis can obstruct the arteries that feed the spine, and diminish blood flow resulting in disc degeneration. Any intervention reversing atherosclerosis will have the potential to halt and even reverse LS. Diet rich in fruits and raw vegetables with zero animal food/diary product (as in DIP Diet) has proven to reverse atherosclerosis⁸ and also has shown reduction of symptoms of osteoarthritis⁹ (table 3). Ahara is said to be Mahabhaisajya by Acharya Kashyap (one is capable to make man disease free only with the food). Agnikarma along with DIP diet gives relief in all sign and symptoms within 1-month procedure with 3 months of follow up and thyroid report within in normal range as seen in figure 1 & 2. This highlights that Kati Sandhivatavata can be managed with Agnikarma and DIP diet and can be managed effectively without any medications.

DEPARTMENT OF ENDOCRINOLOGY AND METABOLISM
AIIMS, New Delhi-110029
आर्य समाज, दिल्ली-110029

Sample No: 04/1000001
Age: 55 years 8 months 25 days
Ward Name: _____

Name: S. K. Kashyap
Lab Ref No: 1000
Referral Time: 10/08/2019 09:50 am

Report

Test Name	Result	Normal Range
T3	0.35	• 0.3 - 0.4 ug/dL
T4	1.15 (1.15 ug/dL)	• 0.27 - 0.42 ug/dL
TSH	0.740	• 0.05 - 1.7 ng/dL

Prepared By: _____
Checked By: _____
Reviewed By: Dr. Nanda

Fig. 6.Investigation before DIP Diet

Department of Rog Nidan and Vikriti Vigyan
Clinical Pathology Lab

Patient Name: S. K. Kashyap
Age/Sex: 57/E
OPD/Ward/ID No: _____
Sampling Date & Time: 14/02/2020 9:31 AM
Specimen: Blood

Lab Ref. No: 06
Consultant: Dr. S. K. Kashyap
UHID No: 3920082
Reporting Date & Time: 14/02/2020

LABORATORY REPORT - THYROID PANEL

Test Description	Result	Unit	Reference Range
Tri-iodothyronine (T3) (Method: CMIA Method)	1	ng/mL	0.87-1.78
Thyroxine (T4) (Method: CMIA Method)	1	µg/dL	6.09-12.23
TSH (Method: CMIA Method)	1.94	µIU/mL	0.34- 5.60

Prepared By: (Lab Technician) 14/02/2020
Checked By: (Lab Quality Manager)
Reviewed By: (Consultant Biochemist)

Fig. 7.Investigation after DIP diet

Conclusion

This case report showed that Agnikarma Procedure along with DIP diet is safe, potent and effective in the treatment of Katigata Sandhi Vata (LS) and it also improved the quality of life by enhancing their daily routine. There was no adverse effect found during and after the whole procedure in this case.

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Effect of plant- based diet (DIP diet) and GK3 Kasaya (decoction) in Madhumeha (type 2 diabetes mellitus)

Dr. Ram Adhar Yadav¹

¹National Ayurveda Research and Training Centre, Nepal

Abstract:

Our study Effect of plant- based diet (DIP diet) and GK3 Kasaya (decoction) in Madhumeha (type 2 diabetes mellitus) is a randomized clinical trial and the first integrated approach of plant – based diet and Ayurvedic medicines in the context of Nepal. Each participant was admitted initially at NARTC hospital and thus, they were accessibility to close monitoring during their wash out period for 7 days. During the 7 days stay at hospital, the participants did not develop any complications and their fasting and random glucose levels did not sharply increase despite withdrawal of conventional medicines. Thus, it might have created a good psychological impact in the participants resulting in excellent compliance of the study participants. In regards to GK3 (Guduchi, Kutaki, Kakamachi and Khadira) decoction, previous studied have shown anti-diabetic effect mostly in animal models for each ingredient. So, we could not justify whether there were synergistic or antagonistic combined forms of the herbs and there might be a possible chance of drug – drug interaction. We did not perform any pre- clinical studies in GK3 decoction before the clinical trial. The formulation is only based on clinical practice by Ayurveda experts. We observed significant reductions in HBA1c levels with both the plant – based diet (DIP diet) with GK3 decoction group and convention diet group. However, the plant – based diet (DIP diet) appeared to be more effective for glycemic control among T2DM patients compared to the conventional diet. Our effective plant – based diet (DIP diet) approach can be applied for T2DM patients.

Keywords: Plant based diet, DIP diet, Kasaya, Madhumeha , Fruit

Application of derivative in the computation of Vyatīpāta: An example from Drkkarana

Venketeswara Pai R.¹

¹Department of Humanities and Social Sciences

IISER Pune

Abstract:

Drkkarana is an important Kerala astronomical text composed (1604 CE) in Manipravalam. The text deals with the majority of topics discussed in Siddhāntik texts with a special emphasis on the need of observations. Seventh Chapter of Drkkarana is entirely dedicated to the computations pertaining to the Vyatīpāta. It is in this context the author of the text uses the derivative for finding the instant of Vyatīpāta. Historically, the application of derivative is first used by Bhāskara II, in his Siddhāntaśiromani, while finding the instantaneous velocity of the planet. However, it is noteworthy that, in the text Drkkarana it is used in a different context. In this talk, having given a brief overview of the text, we would explain how the author makes use of the derivative, brilliantly, to arrive at the accurate time instant of the Vyatīpāt .

Relative Time and Space in the Bhāgavata Purāṇa and its implications on the size of the Universe

Punit Bhalla¹

¹IIT, Mandi, India, s22047@students.iitmandi.ac.in

Abstract:

Space and time as correlative terms are well accepted in the Bhāgavata Purāṇa. We have numerous instances of relativity of time quoted in various sections of the text. This paper examines the concept of relative space and time as addressed in the Bhāgavata Purāṇa, and the commentaries of the ācāryas, to address the issue of the comparatively smaller size of the Universe mentioned in the text.

Fourth in the series of papers establishing a Mathematical Exposition of Bhāgavata Cosmology, it builds on the concept of a geostationary model that is established previously, as also the value of the yojana at 8 miles, to apply the Lorentz transformation in a thought experiment, to observe how the size of the Universe mentioned in the Bhāgavata Purāṇa compares to that of the modern accepted values.

Keywords: Bhāgavata Purāṇa, Size of the Universe, yojana, Lorentz Transformation

Adoptive Numeration Methods in Indian Astronomy

Pandu Santhoju¹ Punit Bhalla², Prof Laxmidhar Behera²

¹ Indian Knowledge System and Mental Health Applications(IKSMHA) Centre,

Indian Institute of Technology Mandi, Kamand, Mandi, India

² Bhaktivedanta Institute of Higher Studies, Mumbai, India

Abstract:

As many of us are aware that the ancient knowledge in India was preserved and transmitted ‘orally’ until a few centuries back through an unbroken chain of teacher and student. One such preserved branch of knowledge is Astronomy, the study of the luminaries in the sky. The sky and outer space have been a great source of curiosity and one of the main research subjects for mankind. Astronomy studies celestial objects such as planets and stars in space and describes their motion with intense mathematical calculations. It describes different kinds of motion of luminaries using mathematical formulae over a given period of time. In doing so, even during the pre-historic era, they used well-defined number systems and units of measurement for length, weight, time and motion, etc. They have used different method of expressing every possible number using a set of ten symbols, each symbol with a place value and an absolute value (KaTaPaYādi System), a different absolute value for each alphabet (Āryabhaōiya System) or by representing them in equivalent number names (Bhūtaśaākhyā System). Or sometimes they represented the large numbers using the decimal value system also. Thus, the ancient Indian Astronomers have created a legacy of unique number systems for representing large or small astronomical numbers. Here, we will examine some of the popularly known Indian Astronomical or Mathematical Number Systems that were used to present the very complex Astronomy in an easily understandable way. A proper knowledge of these numeration methods widely prevalent during ancient times is very important to make sense of the verses that form part of the ancient Indian mathematical treatises. For example, a person conversant with these numeration methods immediately recognizes the number being described in a Sanskrit verse, whereas others unfamiliar with the traditional number systems decipher the verse with different meaning. Thus, in order to understand the astronomical and mathematical texts of our ancient Indians, a proper understanding of these numeration methods is very much useful. Here, we are presenting the unique contextual meanings and çāstric references of various words that were widely used in Bhūtaśaākhyā Numeration System, which is being used in Sūrya-Siddhānta.

Keywords: Indian Astronomy, Number system, Mathematics, Bhūtaśaākhyā, Āryabhaōiya, Katapayādi, Siddhānta.

Highlights of chemistry, metallurgy and material science from ancient and medieval India

V. Ramanathan¹

¹IIT BHU, Varanasi

Abstract:

When European science was introduced in our country in the nineteenth century, it had a very interesting reception. Given that the Indian mind was engaged in questioning and doubting right from her early days, accepting European science was not a challenge albeit the interim Islamic rule. Along with science came also the social aspects associated with it whereby the altercations between the believers and rationalists of Europe was also brought to India in lock stock and barrel which, in hindsight, is actually irrelevant. Although science is considered universal sans any geography or state machinery, in practice it is quite the contrary. If intellect is shaped by culture, then science is not an exception. Scientific principles and truth are indeed universal but these are not the totality of science. Since human cognition and communication are inseparable from science, the subjective aspects of science need to be taken cognizance of with due diligence. A civilization that has successfully kept her people in good spirit, producing intellectuals and leading the world GDP for the whole of the first millennium and nearly half the second, could not have been possible without stupendous acumen and bhagiratha achievements in science and scientific practices particularly in the field of chemistry, material science and metallurgy as advancements in these disciplines directly impact the lives of the people. In this talk I will highlight a few of these achievements which are illustrious of the science practiced in ancient and medieval India.

Medhyarasayana By Cognitive Wellness

Ashwini Godbole¹

¹Associate Professor, TDU

Abstract:

Nervous System Health

Cognition is the finest function of the human brain which has a major impact on an individual's quality of life. Some of the most common factors which lead to decline in cognitive health are stress, unwholesome lifestyle and age. Maintenance and enhancement of cognition is very vital not only for fulfilling all the required mental and physical tasks at all ages, but also for reducing risk of getting age-related neurodegenerative disease (Blagosklonny et al 2009)

Paucity of effective and safe nootropic solutions

Function of the nervous system is an important topic of bio-medical research. Scientific research in the recent past has come up with detailed understanding of structural details of normal and diseased nervous system; brain in particular (Bossy-Wetzel et al 2004). However, very few well researched solutions are available for enhancement and maintenance of health of the nervous system. In want of increasing cognition, healthy individuals often use drugs prescribed for Alzheimer's disease or other memory disorders. Long-term use of such drugs can often lead to undesirable side effects and physical/psychological dependence. Taken together, currently available mainstream solutions are unfit for positive/preventive use for health of nervous system and cognitive enhancement (Mattson, 2007, Pohanka 2011). Thus, there is a critical need for development of solutions for management and prevention of the neurological disease/disorder as well as for 'PROMOTION of HEALTH'.

Ayurveda for nervous system health

Ayurveda has concepts and elaborate descriptions of cognition and other functions of the nervous system (Susruta Sutrasthana 2/3, Charaka Samhita VS 8/8). Ayurveda suggests many practices and Medhya-dravyas or Medhyarasayana (herbs, foods and formulations) for enhanced cognition, sensory and mechanical abilities. According to Ayurveda 'Vata' is a critical physiological factor for nervous function and its derailment leads to 'Vatavyadhi' which can be correlated to declined function of brain and neurological-neurodegenerative diseases.

The theoretical knowledge including concepts and principles of Ayurveda are complemented with equally strong practice. However, both the concept and practice are largely not backed up by

contemporary scientific evidence (Singh and Rastogi 2012). This has led to limited acceptability and use of potentially very effective health solutions from Ayurveda.

We, a team of scientists and doctors from Transdisciplinary University (<http://tdu.edu.in/>) and NCBS-TIFR (<https://www.ncbs.res.in/>) are conducting community based clinical research in the field of Ayurveda guided memory enhancement. We would like to share our preliminary findings with you and appeal for your participation in this socially relevant research.

Mind, Brain and Consciousness: Perspectives from Ayurveda

Dr. C. Ashwin Chandra¹

¹Research Officer (Ayurveda), Central Ayurveda Research Institute, New Delhi, CCRAS, Ministry of Ayush.

Abstract:

Since eons, mind and consciousness have remained obscure to contemporary modern science, however, the Indian Knowledge Systems including Ayurveda and Yog have delineated them very lucidly. Ayurveda psychology follows the Vaisheshika and Sankhya schools. Life according to Ayurveda is a conglomeration of body (sareera), the sensory and motor faculties (indriyas), mind (manas), and the soul/consciousness (atma). This is a continuum where the body proper is the non-sentient and the soul is the sentient end with indriyas as the interphase between the inert body and the higher consciousness. Manas is considered as a 'Ubheyendriya' and 'Karanadravya', which is at supersensual level in the body, an instrument of Atma, seat of all vedanas and a mediator in the knowledge gaining process activating indriyas towards the objects. Manas is asareerika but deeply related with sareera, acetana but is essentially related with Atma, abhoutika but depending reciprocally on pancabhautika sareera in performance of complex and integrated activities of organic life. Mastishka (Brain) is considered as the seat of Cognitive functions and Hridaya (Heart) as the seat of emotional functions of Mind. The dynamics of mental functions are operated through the faculties of Dhee, Dhriti, Smirti and the attributes of Sattva, Rajas and Tamas. These attributes are responsible for three basic Manasika Prakruti types which on finer consideration are further divided into 16 personality traits. Sattva is considered as Mano guna and Rajas and Tamas as Mano doshas, balance state is primordial for Mental well-being and imbalance is the basis for mental disorders.

Keywords: Ayurveda, Mental Health, Consciousness, Cognition, Sattva, Manodosha

Harmonizing Minds: Ayurvedic Approaches to Mental Wellness and Pioneering Research by CCRAS in Mental Health

Dr. Srinibash Sahool¹

¹Research Officer (Ay), Scientist-4, RARIM &MMR, Bengaluru (Peripheral Institute of CCRAS),
Ministry of AYUSH, Govt. of India.

Mail id- srinibash1970@gmail.com, Mob.No-9448941203

Abstract:

Ayurveda, the science of life, places profound significance on the intricate realm of the mind, known as Mana, deeming it one of the three foundational pillars of existence alongside the body and soul (Ch. Su.1/46-47). Within the holistic embrace of Ayurveda, mental well-being emerges as an inseparable component of Swasthya, entwined harmoniously with physical and spiritual equilibrium (Su. Su. 15/10). The nuanced understanding extends to Manasa Vikara, a term encapsulating the delicate state of mental health marked by an imbalance in Mansasika guna, particularly the interplay of Rajas and Tamas. Within this intricate tapestry, Alpasatwa, or a fragile psyche, assumes a pivotal role, acting as a linchpin that renders an individual susceptible to the multifaceted landscape of mental health-related conditions. The body and mind share an inseparable relation and serve as an abode for physical and psychological conditions (Ch.Su.1/56). The approach to managing mental health conditions in Ayurveda unfolds as a rich tapestry of multidimensional interventions. These include the administration of panchakarma (Bio-cleansing) therapies, Medhya Rasayana (nootropics) drugs, and Satwavajaya Chikitsa (Counseling / Psychotherapy) (Ch. Su.1/ 58), which helps to regulate mind/subjugating mind from unwholesome interactions-further, enriching this therapeutic tableau with inclusion of Daiva Vyapashraya Chikitsa (Spiritual Therapy / Devine Therapy) (Ch. Su. 11/5),Sadvrittis (good codes and conducts), and pathya (specially satvik diet) contribute to more favorable outcomes. The Central Council for Research in Ayurvedic Sciences (CCRAS) is a preeminent research institution in India, operating under the esteemed Ministry of AYUSH, Government of India. This distinguished council spearheads myriad research endeavors, encompassing literary explorations, clinical invetions, pharmaceutical studies, and more. Particularly noteworthy is CCRAS's unwavering commitment to advancing the frontiers of clinical research, delving into the intricacies of mental health through strategic collaborations with eminent institutions such as NIMHANS, AIIMS etc.This papermainly highlights the Ayurveda-based pharmacological and psychotherapy for the management of various mental health conditions, highlighting the various research findings carried out by CCRAS on Mental health.

Keywords: Manasa Vikara, Satwavajay Chikitsa, Medhya Rasayana, CCRAS

Optimizing Mental Health Through Dietary Advocacies: Insights and Wisdom from Ayurveda

Dr. C. Sudha Kumari¹, Dr. Bharti²

¹Research Officer (Ay.), Central Ayurveda Research Institute (CARI), Central Council for Research in Ayurvedic Sciences (CCRAS), Under Ministry of Ayush, New Delhi.

²Director (Institute), Central Ayurveda Research Institute (CARI), Central Council for Research in Ayurvedic Sciences (CCRAS), Under Ministry of Ayush, New Delhi.

Abstract:

The Chandogya Upanishad's adage, "अन्नमय हि सोम्य मन," encapsulates a profound truth: the essence of our food shapes our minds. “*Pancha bhoutika theory*” in Ayurveda underscores the pivotal role of food, describing it as a support pillar of life's tripod. Within Ayurveda's functional dynamics, the interconnectedness between 'Psyche' and 'Soma' is central. The body's structural and functional elements—*Dosha, Dhātu, Mala, and Ojas*—are sustained, depleted, or disrupted by dietary influences. Similarly, food impacts the mental attributes - *Satwa, Rajas, and Tamas*, as emphasized in the Bhagavad Gita's delineation of *Satvika, Rajasika, and Tamasika Ahara*. Beyond mere sustenance, balanced nutrition is pivotal for nurturing a positive mental pursuit. Ayurvedic texts vividly detail the repercussions of *Viruddhahara*/incompatible, impure, or corrupted food in the genesis of mental illnesses. Ayurveda's dietary guidelines resonate deeply with maintaining a healthy gut microbiota. Recent scientific developments in the understanding of the gut-brain axis affirm this link, leading to emerging disciplines such as 'Nutritional Psychiatry' echoing Ayurveda's delineation to “*Pathya Ahara*” for healthy and diseased. Food is highlighted as “*Maha- bhaishajya*” and have rejuvenating attributes. Daily intake of congenial food as per one's constitution, habituation, seasons, geographical preference is pertinent to prevent illness and attainment of longevity with excellence of higher mental functions. The dietary instincts and fallacies during pregnancy is determinant in the intellectual development of the progeny. Intriguingly, core concepts like Nootropics, Nutritional Psychology, Nutritional Epigenetics, and Psychoneuro-immunology, now gaining attention, have been ingrained in Ayurvedic teachings for ages and invite exploratory research through a multi-disciplinary approach.

Keywords: Ayurveda, Diet, mental health, nutritional psychiatry, Nootropics, gut microbiota, psychoneuro-immunology.

Prevention of Mental illness - Ayurvedic perspective

Dr G V Ramana¹

¹R O (Ay) In charge, RARIM & MMR, Goa, CCRAS.

Abstract:

It is estimated that disability adjusted life years (DALYs) loss due to mental disorders is much higher than some of the communicable diseases. It is expected to represent 15% of the global burden of diseases by 2020 and the common disorders being depression, anxiety and harmful substance indulgence. In India about 2-3 % are affected with serious incapacitating mental disorders whereas 15% are presenting with behavioral and emotional disorders. A person is said to be mentally healthy when he/she is having a perfect state of balance with the surrounding world, having harmonious relation with others, having intelligence, memory, learning capacity, normal judgment, good self-control and solves any situation intelligently, has self-confidence, cheerful, calm and satisfied with what he possesses.

Ayurveda, the science of life, advocates principles for maintenance of positive health and longevity. The primary aim of Ayurveda as described by Charaka is to preserve the health in a healthy individual and curing the diseases in the diseased. The combination of body, mind, senses and consciousness is considered as 'Ayu'. They constitute a tripod, upon the meaningful combination of which life exists. These are the abodes of health and diseases, proper interaction of these results in happiness. The soul is eternal and is detached from happiness or misery.

Human body is regarded as an indivisible component interacting with the influences of the environment. This interaction results in the functional and emergent phenomenon known as 'life'. The body and mind are equally involved in the disease process hence the correct attitude of the mind is responsible for quick and complete recovery from disease. 'There is no medicine more effective than courage, in a diseased person. The pathogenesis of mental disorders occur due to mental attachment with worldly affairs. This attachment leads to generation of kama which in turn leads to hallucination or confusion which finally leads to vitiation of memory causing budhinasha. This leads to all types of mental disorders. Mental afflictions are to be treated with knowledge about self, about indriya, proper memory and concentration. The person who is free from misconduct of mind, speech and body enjoys health, wealth and acquires spiritual merit.

Keeping in view of the heavy burden of mental illness in the community and its impact on human life, it is essential to incorporate preventive strategies. Adaptation of Ayurveda concepts explained under Sadvritta, Achara rasayana effectively constitutes a preventive strategy for mental disorders.

Keywords: Ayu, Achara Rasayana, sadvritta

Ayurveda in Child Mental Health

Shobhit Kumar¹

¹Research Officer, NITI Ayog, CCRAS

Abstract:

India is home to 44.4 crores children (0-18 years), i.e., 39% of the nation's total population (Census 2011)¹. This population's mental health and well-being need to be prioritized to secure a healthier and stronger future for the country. The common mental health issues reported among students in a survey conducted by NCERT (2020) in middle and senior-level schools include frequent mood swings (43%), dissatisfaction with body image (45%), anxiety (81%), etc. The National Mental Health Survey 2015-16 reported a 7.3% prevalence of mental morbidity among adolescents aged 13-17 years. The studies have reported that the prevalence of depression, panic disorder, generalised anxiety disorder, and suicidality increased with age². Health-promoting and preventing measures advocated by Ayurveda including the practice of *Dincharya* (Daily Regimen), *Rit-ucharya* (seasonal regimen), *Aahar* (diet), *Pathya* (wholesome)/ *Apathya* (un-wholesome), Yoga, meditation, *Sadvrutta* (good conduct/behavior), *Achar Rasayan* (rejuvenation through right code of conduct) have great importance in maintaining optimum health including mental health. The mental health of the child is taken care of even before birth by advocating special therapeutic procedures to the couples to get them tuned physically and mentally for the conception of a wholesome child. During pregnancy, *Garbhopaghaataakara Bhavas* are mentioned, which are to be avoided for the well-being of the fetus. After birth, many interventions have been mentioned, like *Jaatakarma*, which plays a very important role in the healthy development of the child, including boosting immunity and cognitive abilities. Similarly, *Medhya Rasayanas* have been advocated, which are a group of medicines to improve the individual's cognitive functions; besides, they correct various psychological and psychosomatic problems. Additionally, Ayurveda has provided specific guidelines for handling children to prevent psychological illnesses. Ayurveda has advocated three treatment modalities for the management of diseases, viz. *Satwawajay* (subjugation of mind/counseling), *Yuktivyapashray* (logic-based treatment), and *Daivyapashray Chikitsa* (spiritual therapy). These modalities have a specific role in the management of mental illness.

Keywords: Ayurveda, mental health, mental illness, *Satwawajay Chikitsa*

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¹ Operational guidelines for Ayushman Bharat School Health and Wellness Program.

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Translational Research Outlook of Panchakarma Therapies for Mental Illness

Dr Remya E¹

¹Research Officer (Ay), National Ayurveda Research Institute for *Panchakarma*, Cheruthuruthy, CCRAS

Abstract:

Introduction Ayurvedic Medicine is popularly known as Holistic Medicine as it addresses biological, psychological and spiritual dimensions of health and illness¹ and it relies on a comprehensive programme that includes dietary, lifestyle, behavioural, psychological and pharmacological interventions for a prolonged and successful health-span. This authoritative mind-body-spirit medicinal systems presents a unique approach of treatment package better known as Panchakarma and it specifically includes five bio-purificatory procedures ie. Vamana (Therapeutic emesis), Virechana (Purgation), Nasya (Errhine), Vasti (Therapeutic enema) and Raktamoksha (Blood-letting therapy) and generally refers to all the external therapies like Dhara (Medicinal irrigation), Shirotala (application of medicine over bregma), Abhyanga (oil massage) etc. This group of therapies assists the body and psyche to maintain the homeostasis, rapidly rejuvenate the worn-out tissues and thus easily facilitate the attainment of the desired pharmaco-therapeutic effects of medicines administered thereafter.

Keywords: Ayurveda, Panchakarma, Mental illness, psychiatry, unmada

Materials and Methods

The group of Panchakarma therapies which can maintain the balance of psycho-neuro-endocrine systems and can effectively address the psychological imbalances include Vamana, Virechana, Nasya, Vasti, Abhyanga (oil massage), Murdhataila (Therapeutic oil application overhead) and other Keraleeya Panchakarma therapies like Shirotala. This complex intervention programme can also assist the individual's adherence to healthy behavioral patterns. P5 (Predictive, preventive, personalized, participatory and Precision) medicine can be beautifully incorporated by the Panchakarma treatment for the prevention and management of psychological imbalances

Results

Appropriate selection of therapies and drugs based on Dosha predominance is quintessential for achieving the preventive and therapeutic potential of Ayurvedic Panchakarma therapies. Though blood-letting therapy has been mentioned for the treatment of mental illnesses in classical Ayurvedic texts, its

therapeutic potential is yet to be explored. Categorization of Panchakarma procedures for the management of mental illnesses based on phenotypic and Doshic variability will be discussed in detail.

Discussion and Conclusion

Neurobiologically informed, standardized Panchakarma protocols with integrative approaches can yield better results in the management of acute mental illnesses rather than stand-alone Ayurveda single drug therapy. Maintaining a pluralistic healing environment is the need of the hour for preserving the mental health of the population. This paper will discuss the practically oriented and scientifically proved Panchakarma therapies for the maintenance and restoration of both physical and psychological health as the body and psyche are interlinked in all aspects.

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Mind Brain interaction from an Ayurvedic perspective

Dr. Shankar Prasad Adluri¹

¹Associate Professor, The Sanskrit Library

Director of SIVAS Health and Research Institute, Secunderabad, Senior Consultant Physician at
Sunshine Hospitals, Hyderabad

Abstract:

Mind Brain interaction continues to garner one of the highest scientific attention in present time, due to its close relationship to Human consciousness and existence apart from its utility for many upcoming technologies. Still a lot remains to be understood in this very complex domain. Ayurveda is an ancient Vedic medical science deeply rooted in, and utilizing the consciousness based understanding of Life of Vedic darshanas. Hence it can provide some interesting inputs into this complex question from a meditative or intuitive understanding of its Acharyas, which apart from being relevant can have great implications in many areas of science and medicine.

Concept of consciousness and its implications in Ayurveda

Dr. Tribhuwan Sharma¹

¹MBBS and MD (Internal Medicine)

Abstract:

In Ayurveda consciousness is classified into two - (i) Avyakta Atma (unmanifested), which is the cause of whole universe and is unchangeable (ii) Vyakta Atma (manifested), which manifests itself in the individual. Any activity is performed when Atma and Manas conjugate. Though Manas is active it is unconscious and hence cannot function without the presence of Atma which is conscious (Chetana Dhatu). This Atma (consciousness) is the ultimate reality and transcends all physical and psychological phenomena. Though Ayurveda deals with the ailments of mind and body like other systems of medicine, its concept of consciousness inherited from vedic philosophy makes it unique in its approach and aims. This will be discussed in the presentation.

Daiva Vyapasraya : An Ayurvedic approach to health through consciousness

Dr. Vikas Neelakandhan¹

¹Ayurvedic Medicine and Surgery (BAMS)

Abstract:

The world is observing an alarming increase in the number and intensity of psychological maladies nowadays. In these circumstances, it is imperative to examine how Ayurveda, one of the oldest medical sciences with its own psychiatric principles, is relevant to deal with the present day mental health issues. Ayurveda proposes three streams of treatment – (i) Daivavyapasraya (ii) Yuktivyapasraya and (iii) Satwavajaya. While Daivavyapasraya is the healing of psychosomatic ailments using the application of consciousness, Satwavajaya deals with psychosomatic ailments by behavioral corrections etc., and Yuktivyapasraya treats psychosomatic ailments using medicines and therapies. A profound understanding of daiva vyapashraya chikitsa will give us an insight of using consciousness to heal the mind and body. In that sense, the study of daiva vyapashraya is very relevant. The presentation will explore this.

Comparative analysis of models of perception in Cognitive Psychology, Yoga Sutra and Bhagavata Purana.

Parveen Kumar ¹

¹IKSMHA, IIT Mandi

Abstract:

One of the unsolved problems of neuroscience is the problem of perception [1]. It raises some fundamental questions. How does the sensory information get converted into the subjective experience of the world?[2] The apple which I am perceiving with my eyes is really red or not? Are we perceiving the external world directly or indirectly? Is reality mind dependent? Which view is correct- direct realist perspective or indirect realist or idealist perspective? How can we know that our experiences are a true representation of reality? Also do the color, taste, smell, sound, form, and touch exist in the subject's mind or do they have real existence in the world? Is reality an individual experience or common to all? Our senses seem to have inherent limitations to perceive the world as it is? The problem of perception arises due to the probability of errors in the cognitive functions used to process information coming from sensory modalities.[3] In this paper we will try to understand the problem of perception from three different angles. One from Cognitive psychology perspective, and other two from Indian Knowledge system (IKS) perspective i.e., from Yoga Sutra of Patanjali and from Bhagavata Purana. We will compare these different perspectives and will try to develop an Integrative model of perception taking inputs from all the ideas coming from these models. Extended version: The paramount importance of perception (the conscious sensory experience), the awareness of the world through the senses of sight, sound, taste, smell, and touch, can't be underestimated in our lives. Without perception, we can't navigate through this world. Even the simple question like 'Is Apple really red?' cannot be satisfactorily answered. One of the central themes of the analytic philosophy in the 21st century is to understand the nature of perception.[4] The debates about true nature of reality, and its perception through knowledge acquiring senses had been the hot topic of discussion in six ancient philosophical systems of India, in Upanishads, in Puranas, Yoga texts like Yoga Sutra and Yoga Vashishtha, etc. In Ancient Greeks, Plato through his famous 'allegory of caves' considers the reality from two angles of vision, one is the 'world of being' - the fundamental reality and other 'the world of becoming' – the world which we experience through our senses which is different from the 'world of being'. In Western academia, these debates between idealism, direct realism, and indirect realism or representationalism are going on since the time of Newton and then almost every prominent western philosopher like Descartes (with its mind-body dualism), John Lock, Berkeley, Hume, Kant, Mill had discussed and debated about the theory of

perception. Berkeley propounded idealism that there is nothing beyond the veil of perception (matter did not exist) whereas Kant suggested there is ‘noumena- ‘the thing in itself’ and stressed about the unknowability of noumena. The philosophies like Popper’s falsificationism, Hume’s analysis of cause and effect, the problem of induction, Poincare’s theory of conventionalism and Kuhn’s theory of scientific revolutions talk about the problem of perception in similar terms. [5] Recently, with the advancement of Cognitive psychology, based on experimental data, new theories have come up to explain the nature of perception, however still the real mechanism of perception is unresolved. How the physiological changes in the neural networks in the brain (NCC) transformed into real experiences, also termed as a hard problem of consciousness, this enigma, is still unresolved. How do the Na⁺ and K⁺ ions following across the neuronal cell membrane or the action potentials of the nerve impulses that result from this flow transforms itself into the experience of red color of an apple or the motherly love for its child or happiness we feel after getting our desirable object. The standard neuroscientific answer to this problem is the release of serotonin in the brain which characterizes happiness perceived by Mind which itself is the epiphenomenon of brain. But this does not solve the problem of the linguistic divide between serotonin and happiness [6]. Serotonin is different from being happy. How the bottom-up processing assisted by top-down processing results in the vivid subjective experience is a riddle to which it seems no real solution is coming soon. The Indian knowledge system also talks about various theories of perceptions, especially the six systems of Indian philosophy, the Shad Darshanas. In this paper, we will discuss theories of perception mainly from two systems, namely Yoga and Vedanta. In Yoga, we will talk about the Yoga Sutra of Patanjali and In Vedanta, we will talk about the Bhagavata Purana. Here perception goes beyond the physiological changes in the neural networks. Both Yoga and Vedanta philosophy accepts the ontological existence of Antahkarana which includes Manas (Mind), Buddhi (Intelligence), Ahamkara (Ego principle) in Yoga Philosophy and is represented by Chitta. Whereas Bhagavata Purana talks about Antahkarana which includes Chitta (contaminated consciousness) as a separate ontological entity apart from Manas (Mind), Buddhi (Intelligence), Ahamkara (Ego principle). And beyond this Antahkarana is the Real Self, the Purusha, the Experiencer, the subject which is the source of Consciousness in the body.[7] The Yoga and Bhagavata Purana talks about the interplay between real world qualities (phonemes that represent meanings – the objective semantic information), senses both subtle as well as gross, Pranas, tanmatras (the subtle vibration in the form of sensations), Antahkarana and Self which provides a worldview wherein there is no perceptual difference between real world qualities & meanings and their experience by the self. Pranas which exist in the nervous system connects the mind and the body, and carries signal from the physical world (sense object, Indriya Vishya) and imprints samskara on the Chitta and colors the mind due to its proximity like a crystal.[8] Intelligence aspect of the Chitta replicates the external or physical features of the object, that is, it assumes the shape and contours of the object psychically and then presents this image to Purusha, which

becomes aware of it by its consciousness reflecting on or pervading the Chitta through the subtle process known as Samyoga. Both Yoga and Bhagavata Purana further talks about Yogic Perception, non-sensuous perception also known as 'atindriya pratyaksha' which is the experience of the Purusha, the self, beyond the modalities of the material senses. This also explains the spiritual experiences of the practitioners. The theory of perception as propounded by Yoga and Bhagavata School is limited by its dependence on certain ontological entities whose empirical evidence is difficult to prove. So, this paper will discuss the limitations and explanatory powers of the models of perception based on Cognitive psychology, Yoga and Bhagavata Purana and will try to reach a conclusion wherein all these approaches can learn and unlearn from each other and a cohesive theory of perception can be propounded.

Keywords: Idealism, Direct Realism, Indirect Realism, Yoga Sutra, Bhagavata Purana, Semantic information, Chitta, Manas, Ahamkara, Buddhi, Purusha, Atindriya Pratyaksha, Samyoga, Antahkarana

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The Locus of Perception

Nithin Nagaraj¹

¹ Consciousness Studies Programme, National Institute of Advanced Studies

Indian Institute of Science Campus, Bengaluru, INDIA

Abstract:

Contemporary discussions and dialogues in cognitive neuroscience on the nature of perception begin and end with the brain. In virtually 100% of these studies on neural correlates of perception, cognition, memory, attention or consciousness, the emphasis is always on the word ‘neural’ which invariably assumes the locus to be the brain/central nervous system. However, all darshanas in Indian philosophy, without exception, completely ignore the brain in their analysis. The analytically rigorous and erudite Indian philosophers of these schools do not posit the locus of perception (and consciousness) to be the brain or in the body. Thus, we observe a very serious departure or divergence between the modern/western (cognitive neuroscience) and ancient/eastern (darshans) approaches to ‘perception’ and ‘consciousness’. While the correlation between activities in various brain regions and perception/conscious experiences is not doubted, it is the origin or generative cause that should be in serious question (but rarely discussed in most modern scientific theories). In this study, I argue that existing clinical evidence of near death experiences, mediumship & psychedelic experiences, as well as, meditative/contemplate states indicate almost always an inverse relationship between transcendence, lucid perception and brain activity. Can we build a case that when it comes to perception and consciousness, we must not make the mistake of assuming the primacy of space-time-matter? But rather, start with Consciousness as primary and ontologically fundamental – much like our ancient darshanas. Modern developments in physics (amplituhedron, decorated permutations etc.) are also pointing to the doom of space-time as fundamental to reality.

Keywords: perception, neural correlates of consciousness, darshanas, transcendental experiences, spacetime

Freedom of consciousness and the dictates of thinking in the context of the phenomenology of perception

Dr. Sokol Vladimir Borisovich¹

¹Head of Bhaktivedanta Institute ISKCON-Mayapur (2022-2023) (India)

¹Advisor to General Director (Division of the Directorate of the engineering company CJSC LOTUS (2017-2023) (Ekaterinburg, Russian Federation))

Abstract:

Consciousness is the highest category of knowledge. There is no point of observation and investigation external to consciousness. Consciousness knows itself. Knowledge of consciousness, therefore, is always self-consciousness. Cognition of consciousness is a universal human experience, and it is this experience that was called philosophy. Thus, philosophy is an extremely subjective branch of knowledge. As soon as philosophy recognizes that it deals exclusively with the subjective experience of knowing the world and oneself, it becomes phenomenology - the methodology of self-awareness.

Husserl and the Bhagavata Purana offer a scientific method of disidentifying consciousness and thinking, which allows one to overcome the dictates of thinking in favor of liberating consciousness, thereby returning science to reliable knowledge, up to the Absolute Truth. The Bhagavata Purana is one of the best examples of phenomenological philosophy in the entire world. Of particular interest is the fact of direct correlation of the methodology of self-awareness of the Bhagavata Purana with the teachings of the founder of European phenomenology, Edmund Husserl.

In accordance with the phenomenology of E. Husserl, consciousness functions through acts of perception. In general, perception is the central problem of Husserl's phenomenology of cognition, through the solution of which it is shown how human consciousness "works" at a level preceding scientific theory ("pre-predicative" level). Analysis of perception is the main problematic block of this level, isolating the invariant structures of consciousness. Husserl was the first philosopher to analyze the act of perception in its own significance, in its essential difference from sensation and the act of thinking. The phenomenological analysis of perception in all its nuances is not reducible either to empiricism, which recognizes only sensations in perception, or to intellectualism (thinking), which does not take into account the sensory component of experience and sees in perception exclusively an act of cognition.

In the analysis of perception, Husserl made two distinctions fundamental to phenomenology. Firstly, the philosopher spoke about the need to distinguish between a perceived thing and the perception of a

thing. Secondly, he distinguished between perception as a holistic intentional act and sensation as the non-intentional “content” or matter of this act.

A necessary stage of phenomenological analysis is a strict distinction between the perception of a thing and the thing itself, a phenomenon and an appearing object. “It is obvious that perception is not a thing.” In its existence, the world does not depend on our consciousness (unlike Kant’s philosophical position, where existence is a category or a pure rational concept), but “depends” on our knowledge of it. If the phenomenon or what is given in perception changes, then the thing itself remains unchanged. In perception, only some side of a thing appears to us (some side of the house, the house from the outside or from the inside). But despite the fact that the thing is transcendental (it can never be given to us completely, and we cannot even say anything about its existence), there is a belief (*Glaubhaftigkeit*) that we perceive some specific object.

In perception, we are given a phenomenon, and the object itself is present intentionally, or the “relationship” to the object itself is present. On this basis, Husserl distinguished between the givenness of perception and the perceived thing and, consequently, the distinction between statements about perception and the perceived object. This difference is based on the fact that the phenomenological given is absolute, obvious due to its immanence. Thus, Husserl divides acts of perception into immanent and transcendental.

For Husserl, it is very important to separate the transcendental sphere from the immanent: if the object that appears in perception is transcendence, then perception itself is immanent. To a large extent, the founder of phenomenology is a follower of Descartes. Phenomenological consciousness must include in the scope of analysis, in addition to the Cartesian cogito, also the cogitatum - the object of thought, perception, fantasy. We have the right to talk about two spheres of immanence: firstly, the sphere absolutely immanent to consciousness and, secondly, objectivity included in the sphere of relative immanence.

The inclusion of cogitatum is possible thanks to phenomenological reduction, where we discard what consciousness is not able to guarantee (the existence or non-existence of a perceived thing), and focus on the data of perception itself as an experience immanent in consciousness. Phenomenological reduction “brackets” the very positivity of the existence of objects, giving the right to describe only phenomena, without specifying what they are phenomena of.

Phenomenological reduction is the main technology for disidentifying consciousness and thinking in the “rigorous science” of E. Husserl. The sought-for essence of things is comprehensible exclusively in the phenomenological attitude of cognition, achieved in Husserl’s method through the key procedure of phenomenological reduction of empirical data (eidetic stage of reduction) and rationally constructed. Classical Western epistemology relies on two main cognitive resources: data from empirical experience (through the perception of physical senses) and rational analysis (through logical “processing” of

empirical data). However, E. Husserl notices a significant flaw in the basic theoretical premise of Western epistemology, aimed at searching for the essence of being within the boundaries of the perception of empirical and analytical facts. Husserl categorically insists on the fundamental irrelevance (pseudo-scientific nature) of such a premise, arguing that the essence of a thing or phenomenon can never be reduced to the perceived facts of its manifestation.

The phenomenological attitude of cognition is radically different from the natural attitude in the key understanding of the relationship between essence and fact. The natural attitude is based on a preconceived notion of the identity of essence and fact, while the phenomenological attitude exposes the illusion of their identity. The phenomenological attitude of cognition comes from a clear distinction between two “regions of being”, which are mixed in the illusory unity of the natural attitude.

Thus, the path from “inanimate” thinking to phenomenological consciousness (“living” thinking) according to E. Husserl lies in a break (reduction) with internal discourse and entering the area of experience of “pre-thinking”, living anti-discourse. Phenomenological reduction involves the definition of two types of mind - intentional mind (consciousness) and transcendental mind (thinking).

The Bhagavata Purana also uses a reduction separating consciousness (citta) from manas (mind), buddhi (mind) and ahankara (false ego), as well as distinguishing the mind into shuddha-buddhi and tamasa-buddhi. Thus, the Bhagavata Purana contains a scientific and philosophical methodology comparable to the phenomenology of perception and cognition by E. Husserl. At the same time, the Bhagavata Purana not only implements the phenomenological method of cognition in the form that was described by its founder at the beginning of the 20th century, but also has the potential to overcome the unresolved current problems of modern Western phenomenology.

Perception from Buddhist Yogācāra-Vijñānvāda Perspective

Dr. Buddhadev Bhattacharya¹

¹Associate Professor, Dept. of Philosophy, Nava Nalanda Mahavihara (Deemed University), Under Ministry of Culture, Govt. of India, Nalanda-803111, Bihar.

Abstract:

India has inherited very deep intellectual, philosophical and spiritual traditions. The depth was acquired over centuries of reflections. The reflections were not only on the nature of the physical world but also on the inner and psychological and spiritual world. All the classical Indian philosophical schools that advance epistemologies accept perception as a source of knowledge although there is much disagreement about its nature, objects, and limitations. Are the objects of perception internal to consciousness or external? Are they restricted to individuals, or universals? How about relations? Do we perceive only fleeting qualities (dharma), as Buddhists tend to say, or qualifiers as qualifying qualificanda (a lotus as qualified by being-blue), as say realist Nyāya and Mīmāṃsā? Does all perception involve a sensory connection with an object? These are some of the outstanding issues and questions that occupy the schools in all periods of their literature. The Buddhist Yogācāra-Vijñānvāda subjectivism views perception as “concept-free” and “non-erroneous”. Mīmāṃsā and Nyāya realists emphasize the “concept-laden” nature of at least the type of perception that is epistemically foundational for observation statements containing basic sensory predicates. To be sure, Mīmāṃsā and later Nyāya also admit concept-free perception. Yogācāra holds that all prediction, including the sensory, depends on ideas of unreal generality. Here I will try to touch the heart of classical Indian realism and also idealism.

Perception under Heideggerian philosophy and its offshoots in cognitive science (embodied-enactive cognition, dynamic system theory)

Dr. Navneet Chopra¹

¹Assistant Professor, Department of Philosophy,
University of Delhi, Delhi

Abstract:

Kant proposed a-priori schemas to make sense of the sensory data as perceptions, while developmental psychologists like Piaget proposed those schemas to be the result of interactions of the infant with the environment in a gradual manner. Modularity theorists like Fodor, Pylyshyn and Raftopoulos supported a distinction between 'early-vision' and 'late-vision' for perception, under which the latter part is accepted to be influenced by the top-down processing but not the former, thereby they try to defend modularity thesis for the former. I reject the very relevance of this distinction since, except for some emergencies (like being in a war-situation), in routine life we make perception of a "full" object - we don't just stop at "early" vision, and the relevant cognitive process accomplish it under a thorough going Heideggerian "background" conditions. This process, I propose, involves not merely top-down but a "radical top-down" (RTD) process. Thus, firstly, I make a distinction between "top-down" processing as used in the traditional cognitive science/psychology and "radical top-down" processing as a result of applying Heideggerian phenomenological insights to the process of perception-constitution in a strong sense. The "background conditions" under this RTD involve human embodiment, culturality, historicity, pragmatic-instrumentality of the object under use or the action- affordances (of the object under observation for the 'subject'), intersubjectivity, etc. which characterize our being-in-the-world structure as a "Da-sein", and not just an isolated consciousness. This background understanding underpins a meaningful perception (and, in my view, is akin to what Wittgenstein calls as Form of Life which underpins our sense-making in language), and is not purely top-down or bottom-up, but is integral part of our existence as a Dasein. Further, the pragmatic hammering as action is inherently involved in Heidegger when one ascribes meaning to a hammer in perception in his notion of 'ready-to-hand' (and also in the linguistic meaning of the word 'hammer', in my view). This phenomenon is well corroborated in modern times, under Enactive Cognition, which enables a distinction between a table and a door for humans but not for woodpeckers. Many empirical works like Back-y-Rita's experiments on blinds, Held and Hein experiments on kittens, etc. also offer credence to the notion of 'action in perception' as articulated by Alva Noe. Further, for social perception, esp. in reference to Adolphs studies of social perception, mirroring plays a central causal role in an experiential empathic understanding of the other's mind or mental state. This informs another instance of the role of action in social perception. Further,

perception may also involve an interpretative exercise under the 'predictive processing theory' (PPT) under which the brain tries to make sense of the impoverished (say, visual) information using prediction by comparing it to several meaningful gestalts already present in the memory, and tries to predict the object by minimizing the error between the two by zeroing on that specific perception which causes minimal error. However, I propose that such settling of meaningful perception is not a static process, but involves a dynamic interaction between the subject and the world, wherein meaning "emerges" according to the situation one is in, and doesn't reach to a pre-existing, essentialist, static meaning of the object or the world under perception. This dynamic interplay involves interaction between the bodily capacities, brain processes, environmental conditions and action possibilities it affords, and thus the overall situation one is in. Hence, unlike standard cognitive science, there is no talk of 'representation' here of the external reality in the inner mind/brain. Scholars, like Dreyfus, Hutto, Van Gelder, etc have criticized or avoided the concept of "representation" in their discussions of cognition, perception, and consciousness because that tends to imply a static, passive and linear view of mental processes.

Keywords: Heidegger, perception, being-in-the-world, pragmatic relation, representation, embodied-enactive cognition, dynamic system theory

Scientific Remote Viewing Based on Bhagavata Sankhya Philosophy

V. Sreenivas¹

¹ Senior Principal Scientist, Council of Scientific and Industrial Research (Government of India)

Abstract:

Although there has been numerous compelling evidence regarding remote viewing, both from religious literature and real life experiences, scientific research has not been very productive or conclusive. Despite recorded evidence such as near death experiences, past life regressions, out of body experiences and medical mysteries, the main challenge has been to give proper explanations and repeatable experiments. Current understanding, despite the renewed interest, is that the studies have failed the rigors of scientific methodology and reasoning, leading to the general conclusion that it is a pseudo-science. However, there have been many instances in the history of science where the impossible has become possible by sustained efforts in repositioning ideas and belief systems rather than abandoning endeavors based on repeated failures. One important driving force for inventions has been the benefits that can be derived from seemingly crazy ideas but which can receive shape by creative minds. Analytical philosophy as propounded in the Bhagavatam and other literature give some hints and evidences of how remote viewing is possible by refining our philosophy in the field of cognition / perception and combining it with modern scientific theories such as quantum mechanics, particularly the concepts of superposition and entanglement.

Information and Consciousness

Sanjaya Kumar Lenka¹

¹Indian Institute of Technology(BHU)

Abstract:

This paper studies how Physical Information is perceived and expressed by consciousness and how the mind plays a vital role. Information as a unit of meaning or thought is concerned with truth values of it that are verified by consciousness. Information can be subjective and objective. In the perception of information, consciousness tries to find the sense-impression and sense–datum of Objective information to convert it into subjective information in which the mind as part of consciousness (Prabhupada;1972; BG;8;3) satisfies the D-D condition (doubt and denial condition) and a coherent understanding of information is formulated. It means perception is not a process of effect and cause of objective information but a process of realizing sense-impression and sense–datum through sensory systems. The role of information is it binds objects, mind, and consciousness. The important finding in this research is consciousness, as a life particle having a collective awareness triggers the process of perception and expression of information. The mind is the fourth stage of cognition in which the sensory information is interpreted and conceptualized and thoughts from this sensory information are formulated. After formulation, the thought is verified by consciousness for expression. The qualified departure of this research from the already existing research in modern science, specifically in neurology and psychology is that it believes consciousness is an independent entity that is the origin of all thoughts and intentions. The information patterns created by neurons are designed by consciousness. This study tries to develop an explanation of how the mind formulates different types of axioms based on thoughts. It also argues that there is linearity between perception and expression of information. In Psychology and Neurology Miller;2001,2013, 2014, Cohen;2001, Rigotti, Warden, Fusi;2013, 2016, Roy, Donghue, Antzoulatos, Stefanics, Bhattacharya, and others argue that neurons create a top-down and bottom-up process in the realization of information. In cognition, neurons create two activities as a single selective activity for one thought and mixed selective activities for multiple thoughts.However, these researchers do not recognize the existence of consciousness which is the origin of thought and intention. In this context, this research argues that any kind of pattern that neurons develop must be based on an understanding of proposition and there must be an independent entity in cognition that interprets, understands, and formulates thoughts and compares them with the information regarding the external world for the

expression of information. This independent unit is consciousness which involves itself in understanding the proposition of the physical world and activates neurons in the upgradation of information in cognitive processes (Prabhupada; 1972; BG; 15;15, 7;10,22,) In the analysis of perception and expression of information, this research follows the theoretical assumption given by T.D.Singh, Penrose, Chopra, Agrawal, Rao and Sandip. This paper will mainly discuss how the proposition of the physical world as objective information is converted into different thoughts by consciousness and this thought unit is considered as different signs that are expressed with intention. This paper will fulfill an expectation of knowing how the mind converts raw information to thought and help the researcher develop a model of information structure on the basis of consciousness. This paper also developed a mathematical model of the functional behavior of proposition (meaning) taking place in perception.

Anudhyāna: bhārata kī jñān paramparāyen

Prof. Richa Chopra ¹

¹Centre of Excellence for Indian Knowledge Systems, IIT Kharagpur (CoE- IKS, IIT Kharagpur)

pr̥ṣṭhabhūmi [Context]

The study of mind and behaviour has evolved under the rubric of ‘Psychology’. Although started with a focus on consciousness, it has increasingly attended more and more to the nuances of behaviour with a predominantly physical scientific lens. This positivist and anthropocentric view has led to utter neglect of the inner world, self-awareness, experiential realities and the insights from Eastern perspectives including the Indic Knowledge Systems (such as *Veda*, *Vedānta*, *Sāṃkhya*, *Yoga*, *Āyurveda*, *Nyāya*, *Jyotiṣa* etc.). The ignorance of these indigenous sources of knowledge and relevant insights has led to the acceptance of a lopsided view of reality causing an impoverished perspective on human potential. The prevailing human misery and challenges in establishing a ‘just world order’ demands an expansion of the scope of psychological discourse and adopting an encompassing purview, which has space for due recognition of ‘Consciousness’ and ‘Mind’ in building an enabling paradigm. Progressive expansion of the ‘Self’ is the central construct of ‘Indian Psychology’ – based on ideas and practices embedded in ancient texts such as the *Upaniṣads*, *Bhagavadgītā*, *Yogasūtras*, developed over thousands of years within the Indian subcontinent.

anudhyāna: bhārata kī jñāna paramparāyen - a 2.5-hour special session will permeate multiple traditions to infiltrate and to gradually weave psychological mindedness into theories of the esoteric, and bring out unique healing modalities from the ‘Orient (east) – Occident (west)’ wisdom – aimed in enhancing a multi-dimensional insight in the individual. The session will aim in exploring intersections, ruptures and continuities – towards recalibrating an understanding of the ‘human psyche’ and serve as a catalyst for thinking through change and the emergence of newer perspectives - balancing traditional ‘third-person’ perspectives with the ‘critical first-person’ perspective.

The session facilitated by distinguished scientists, humanists, artists and teachers of psychology and contemplation will be anchored on an inter and trans-disciplinary approach - amalgamating principles from the disciplines of psychology, philosophy, neuroscience, spirituality, musicology, psychiatry, astrology, performing arts and current academic conversations with modern science etc. presented in a totally secular and scientific paradigm.

The objective of the emerging narratives being to know as to how these reveals, conceal, reflect, guide or otherwise engage the audience’s contemplative potential, for exploration and honest application of

psycho-contemplative principles internalised through research, rigorous study, critical self-reflection and embodied practices across all spheres of life.

The session is expected to address not only the gaps in the mainstream psychological science but help promote emotional, intellectual, social and spiritual well-being in the scholars – eventually enabling their life’s Journey towards *Ātmavidyā* (knowledge of Self)”.

Lastly, the Case study of the ‘¹Department of Contemplative and Behavioural Sciences’ - organized around a scientific and an empirical approach, embedded within the framework of a contemplative pedagogy, for the examination of the full range of human experiences and behaviour in an effort to catalogue them, to understand their phenomenology and to comprehend their scientific basis will be revisited.

sūtradhār [Anchors]

Prof. Richa Chopra, Centre of Excellence for Indian Knowledge Systems, IIT Kharagpur (CoE- IKS, IIT Kharagpur) & Prof. Tanusree Chakraborty, Department of Civil Engineering, IIT Delhi

Vaktā [Proposed Speakers]

·**Padma Bhushan Prof. Kapil Kapoor**, Former Chairperson, IAS & Former Rector, JNU |*bhārata kī jñāna paramparāyen evam anudhyāna* | 12 minutes + 5 Minutes of Q & A

Dr. Shekhar P Seṣādri, Former Dean, Behavioral Sciences Division & Former Director, NIMHANS | *Mind, Mental Health and Contemplation: Western Paradigms* | 12 minutes + 5 Minutes of Q & A

·**Dr. Manas Kumar Mandal**, Distinguished Visiting Professor, IIT Kharagpur | Neurophenomenology and Consciousness | 12 minutes + 5 Minutes of Q & A

Pt. Nayan Ghosh, Indian Tabla and Sitar Maestro | *rāga rasa & anudhyāna* | 12 minutes + 5 Minutes of Q & A

Pt. Sanjay Rath, jyotiṣa guru | *kāla jnana* | 12 minutes + 5 Minutes of Q & A

Deepak Khurana, Art of Living Faculty and Research Scholar, CoE-IKS, IIT Kharagpur | The Diary of a *sādhak*: Journey Within from Yogic Paradigms | 6 minutes + 5 Minutes of Q & A

SPL SESSION: Pravrajika Divyanandaprāna, Monastic Member, Sri Rāmakrishna Sārada Math | Facsimilia of Consciousness from Indian Philosophies | 25 + 5 Minutes of Q & A

Neural Correlates of Consciousness: State of art and current status

Dileep. G¹ , Anuj Nandanwar² , Shubhajit Roy Chowdhury³

^{1,2} iHub and HCI foundation, Indian Institute of Technology Mandi, India

³ School of Computing and Electrical Engineering, Indian Institute of Technology Mandi, India

Abstract:

Consciousness refers to the personal, first-hand experience of perceiving scenes, recognizing faces, hearing sounds, or reflecting on one's own experiences. The Neural Correlates of Consciousness (NCC) refer to the most basic neural processes that are collectively required for a specific conscious perception to occur. Figure 1 illustrates these NCC. Identifying the NCC is crucial in both scientific and clinical contexts. Although the frontal cortex is known to play a significant role in intelligent behavior and cognitive control, its contribution to consciousness remains a topic of ongoing debate and uncertainty. It has been widely assumed that consciousness depends on prefrontal circuits, either on their own or in conjunction with parietal regions forming the frontoparietal network. Content-specific NCC encompasses the neural processes responsible for the specific details within consciousness, such as colors, faces, locations, or thoughts. In experiments, researchers typically investigate content-specific NCC by comparing situations where conscious elements are present with those where they are not. The complete NCC can be described as the combination of all these content-specific NCC. In theory, it is possible to estimate the complete NCC by studying the various content-specific NCC. In practice, these two approaches often complement each other and progress in tandem. Figure 2 provides clinical evidence supporting both the Full NCC and the content specific NCC.

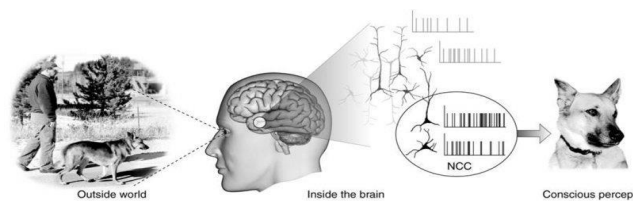


Figure 1: The Neural Correlates of Consciousness (NCC) can be described as the most basic neural processes and elements, in this case, synchronized action potentials in neocortical pyramidal neurons, that are enough to bring about a particular conscious perception or a conscious (explicit) memory.

In recent years, advanced non-invasive imaging methods like functional magnetic resonance imaging (fMRI) have been combined with established technologies such as electroencephalography (EEG), magnetoencephalography (MEG), and positron emission tomography (PET) to study the brain. However, these techniques have limitations, such as their ability to accurately capture spatial or temporal information, and they provide indirect measures of neural activity by relying on factors like blood oxygen levels, external electrical and magnetic signals, or the detection of glucose consumption using radioactive substances. Despite progress in understanding the neural basis of consciousness, there

is still no consensus among neuroscientists on the essential neural mechanisms that underlie conscious experiences in humans and primates. In this article, we explore different perspectives on the NCC and examine the implications and predictions they offer.

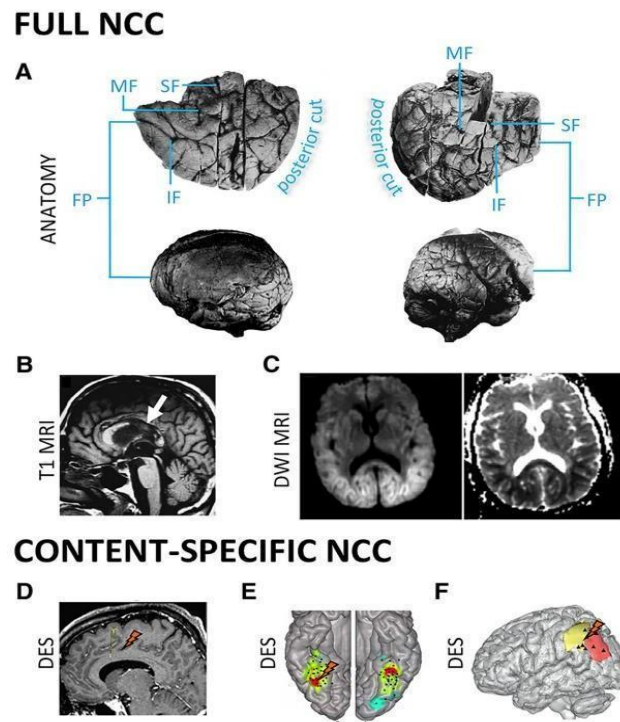


Figure 2: Clinical evidence for full NCC and content specific NCC

Brain lesion studies have provided evidence for both the involvement and non-involvement of various brain regions in supporting consciousness and its components. Notably, there are cases of patients who maintain a normal level of consciousness despite significant damage to their frontal lobes. The utilization of electrical stimulation in neurosurgical operations is a significant method for obtaining evidence regarding the direct role of specific brain regions in consciousness. This is highlighted by its superior ability to predict postoperative deficits compared to techniques like fMRI or diffusion tensor imaging (DTI), as shown by studies conducted by Penfield (1959), Desmurget et al. (2013), and Borchers et al. (2011). Unlike lesions or electrical stimulation, neuroimaging studies offer less direct evidence about the specific brain regions involved in consciousness (Farah, 2004). In practice, functional activation maps often encompass brain areas that may not be directly linked to the mental process under investigation (Silvanto and Pascual-Leone, 2012; de Graaf and Sack, 2014). For example, both fMRI and intracranial EEG reveal activation in widespread bilateral temporo- occipital areas beyond the fusiform face area (FFA) when faces are presented. However, only when the right FFA is directly stimulated with electricity does it disrupt face perception (Rangarajan et al., 2014, Fig. 2D).

The most straightforward approach for identifying the entirety of the NCC is to utilize paradigms in which individuals maintain a consistent internal mental state without participating in specific tasks (as shown in Fig. 3A-D). These paradigms are effective in reducing potential issues arising from changes in behavioral states, allowing for a clearer separation between consciousness and factors like behavioral responsiveness and task performance. Concerning the contents of consciousness (depicted in Fig. 3E-L), using stimuli that have no relevance to the ongoing task allows for a sharp separation between the true NCC and the diverse cognitive functions required for task-related behavior.

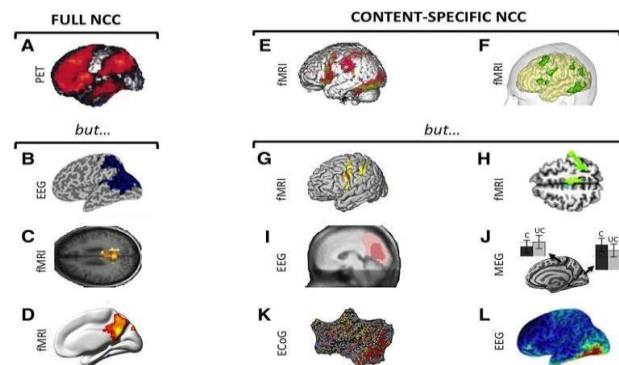


Figure 3: Neuroimaging, Forward inference.

Evidence from diverse studies, including those involving lesions, stimulation, and recordings consistently suggest that the rear regions of the cortex, commonly known as the "posterior hot zone," play a direct role in determining the contents of consciousness. New findings suggest that the anatomical neural basis of consciousness is mainly located in the posterior cortical region, which includes sensory areas, rather than being linked to a fronto-parietal network responsible for task monitoring and communication. The extensive volume of causal interactions occurring in the brain, along with the transient nature of numerous experiences, present difficulties for even advanced experimental methods aimed at understanding the NCC. Defining an NCC as a correlate of consciousness does not necessarily mean that an NCC will be a system primarily or exclusively devoted to consciousness, or that it will represent the primary brain system responsible for generating consciousness. The quest for NCC represents an appropriate central focus for the expansion of the consciousness science field and a pivotal initial step in the endeavor to develop a comprehensive theory that explains the connection between physical processes and conscious experiences. The current state of scientific knowledge regarding consciousness is progressing and maturing. Nevertheless, it is crucial to conduct detailed and extensive theoretical research to properly assess the empirical evidence related to the NCC. Determining the precise neural prerequisites for consciousness, which are both essential and adequate, goes beyond simply pinpointing where conscious-related activity occurs or does not occur in the brain.

Exploring the Interplay between Neuroscience of Digital Addiction and Yoga Practices: Implications for Holistic Intervention

Divyansh Pandey¹, Arnav Bhavsar²

¹ Indian Knowledge System of Mental Health Applications, IIT Mandi, HP, India

² School of Computing and Electrical Engineering, IIT Mandi, India

Abstract:

The rapid proliferation of digital technologies has transformed the way individuals interact with information, entertainment, and social networks. However, this digital revolution has also given rise to a growing concern: digital addictions. Defined as compulsive and excessive use of digital devices or platforms, it encompasses a range of behaviours, including social media overuse, internet dependency, and excessive gaming. This review explores the neurobiological correlates of digital addiction and investigates the potential therapeutic role of yoga. We delve into the neural substrates associated with addictive digital behaviours and examine how yoga practices may modulate these neural pathways. The integration of yoga as a neurological intervention for digital addiction holds promise for its potential to modulate neural circuits implicated in addictive behaviours, offering a holistic approach to addressing the neurobiological underpinnings of digital addiction.

Keywords: Neuroscience, Digital addiction, Yoga

Introduction:

As of April 2023, there were approximately 5.18 billion internet users worldwide, constituting around 64.6 % of the global population. Out of this total, roughly 4.8 billion individuals, or 59.9 % of the world's population, were actively engaged in various social media platforms. (Statista 2023). The rapid proliferation of digital technologies in contemporary society has revolutionized the way individuals engage with information, entertainment, and social interactions. While the digital revolution has ushered in numerous advantages, it has also sparked a mounting concern: the prevalence of digital addiction.

Defined as the obsessive and excessive application of digital devices or platforms, digital addiction encompasses a range of behaviours, including social media overuse, internet dependency, and excessive gaming (Griffiths, 2005; Kuss & Griffiths, 2017, Christakis, 2019). Digital addiction is a comprehensive category that encompasses various forms of addictive behaviours related to digital technology. This includes well-established concerns like internet addiction, the widely debated problem of gaming

addiction, and the relatively new area of focus, whether it be on social media or other forms of media. (Christakis, 2019).

Importantly, digital dependency doesn't exclusively pertain to internet usage. This means it encompasses more than just addiction to activities conducted online. It also encompasses addictive behaviours related to activities conducted offline but facilitated by digital sources of devices as addiction to offline gaming (Almourad et al., 2020). Recent research has shown that a notable number of people from various backgrounds struggle with addictive behaviours related to digital activities. This frequently results in negative impacts on their mental well-being, social connections, and day-to-day functioning (Andreassen et al., 2013).

Yoga, with its potential to modulate neural circuits implicated in addictive behaviours, emerges as a promising adjunctive approach. Studies have indicated that yoga practices influence reward processing, enhance executive functions, and promote neuroplasticity, all of which are integral in addressing the neurobiological underpinnings of digital addiction (Holzel et al., 2011).

This review aims to delve into the neurobiological correlates of digital addiction and explore the potential therapeutic role of yoga. By examining the neural substrates associated with addictive digital behaviours and investigating how yoga practices may modulate these neural pathways, we seek to provide valuable insights into an integrative approach for mitigating the impact of digital addiction.

I. Neural Correlates of Digital Addiction

The brain activity observed in individuals with digital addiction mirrors that seen in other types of addictive behaviour. Operationally, addictive behaviour is any conduct that exhibits any of the six essential elements of addiction: salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse. Any action that satisfies all six requirements is a form of addiction (Griffith et al, 2005).

As previously said, addiction is characterized as a persistent, reverting brain condition that develops as a consequence of a drug's protracted effects on the brain and resulting in obsessive use and abuse. Drug use initially is linked to pleasure (Leshner et al, 1997) and the rewarding effects they bring about via increasing dopaminergic transmission in the mesocorticolimbic brain circuitry (Laviolette et al, 2001). Digital cues like notifications, likes, and in-game rewards trigger the mesolimbic pathway, leading to the release of dopamine and generating sensations of pleasure and reinforcement (Volkow et al., 2010; Kuss & Griffiths, 2012). Dopamine imparts a crucial role in the circuitry responsible for the subjective pleasure linked to positive rewards and the motivational drive behind using substances like food, alcohol, or drugs. (Blum et al, 2018; Wise et al, 2008). Dopamine therefore controls synaptic plasticity to regulate the reinforcement of both healthy and unhealthy response patterns (Koob et al, 2016), a key component of theories of addiction based on neuroadaptation (Goldstein et al, 2011). In individuals who

have been addicted for an extended period, the inability to regulate consumption leads to a reduction in the presence of dopamine receptors in the brain.

Chronic exposure to these pleasurable stimuli in digital settings might result in neuroadaptive alterations that affect the sensitivity and responsiveness of dopaminergic receptors, adding to the addictive character of digital use (Ko et al., 2013). Insufficient dopamine D2 receptors may also contribute significantly to the susceptibility to developing dependence, as a decline in dopaminergic transmission lowers the reward system's sensitivity to natural rewards on a larger scale (Scaplen et al, 2016).

Lack of control and the resulting primary symptoms have been functionally correlated with disruptive processes occurring in the neural networks of the prefrontal cortex. Specifically, this involves alterations in network-specific functional connectivity, resulting in the IRISA (impaired Response Inhibition and Salience Attribution) syndrome, which produces the core clinical indications of drug abuse (Goldstein et al, 2011). According to studies, those who are addicted to digital devices have prefrontal brain dysfunction, and a decrease in functional connectivity which affects their ability to stop behaviour and make decisions (Jin et al., 2016).

Extended involvement with digital platforms has been associated with alterations in grey matter within areas of the brain in charge of cognitive control, particularly in the prefrontal cortex (Yuan et al., 2011). Subjects with Internet Gaming Disorder (IGD) exhibited notable reductions in grey matter and white matter (Wang et al., 2015) as a volume in various regions of the prefrontal cortex. These areas encompassed both sides of the dorsolateral prefrontal cortex (DLPFC), the orbitofrontal cortex (OFC), the anterior cingulate cortex (ACC), and the right supplementary motor area (SMA) (Jin et al., 2016).

II. Yoga as a Neurological Intervention

The practice of yoga, encompassing physical postures (asanas), breath control (pranayama), and mindfulness techniques, has gained recognition for its potential to modulate neural activity and promote mental well-being. Research suggests that yoga may offer a promising adjunctive approach for individuals struggling with digital addiction.

A. Effects on Reward Processing

Engaging in yoga has been demonstrated to have an impact on the reward system in the brain, potentially reducing the reinforcing effects of digital stimuli. Research utilizing functional MRI (fMRI) has shown that practicing yoga can bring about changes in brain areas linked to processing rewards, such as the nucleus accumbens and the ventral striatum. (Froeliger et al., 2012).

B. Enhancement of Executive Functions

The cognitive processes involved in executive functions, including tasks like controlling impulses,

making decisions, and regulating attention, are crucial in addressing the difficulties presented by digital addiction. Research indicates that consistent yoga practice is linked to enhancements in executive functions, possibly due to increased activation in the prefrontal cortex. (Gothe et al., 2019; Villemure et al., 2015). These neurobiological changes may equip individuals with the cognitive tools needed to exert greater control over their digital consumption habits.

C. Neuroplasticity and Structural Changes

Engaging in yoga has been associated with neuroplasticity, which pertains to the brain's capacity to adjust and restructure in reaction to experiences. Studies employing neuroimaging methods like MRI have suggested that participating in yoga sessions might result in physical alterations in the brain, including changes in the density of grey matter and patterns of connectivity. (Villemure et al., 2015). The observed enhancements in cognitive functions and emotional regulation attributed to yoga practice may be rooted in these neuroplastic changes.

The multidisciplinary approach integrates findings from neuroimaging studies, neurotransmitter analyses, and clinical observations, as outlined in research by (Brewer et al., 2011; Gard et al., 2014). It underscores the compelling evidence suggesting that yoga practices exert profound effects on the brain, influencing neurotransmitter regulation, neural connectivity, and stress reactivity. These favourable outcomes appear to be intricately linked with the modification of neural activity and connectivity within brain regions pivotal to emotional regulation, attentional processes, and heightened states of awareness (Novaes et al., 2020).

The integration of yoga as a neurological intervention for digital addiction holds promise for its potential to modulate neural circuits implicated in addictive behaviours. By targeting reward processing, enhancing executive functions, and promoting neuroplasticity, yoga offers a holistic approach to addressing the neurobiological underpinnings of digital addiction

III. Integrative Approaches: Yoga as a Complementary Intervention

Recognizing the complexity of digital addiction, integrative approaches that integrate yoga practices with other therapeutic modalities have shown promise in addressing the associated multifaceted issues.

A. Yoga and Cognitive- Behavioural Therapies (CBT)

Cognitive-behavioural therapy centers on recognizing and altering dysfunctional thought patterns and behaviours linked to addiction (Beck et al., 2015). Through the inclusion of yoga, which fosters mindfulness and self-control, individuals may cultivate heightened self-awareness and better emotional regulation. This enhancement can amplify the efficacy of Cognitive Behavioural Therapy (CBT) (Garland et al., 2017).

B. Mindfulness-Based Interventions (MBIs)

Practices centred around mindfulness, similar to those found in yoga, present a supplementary method for individuals contending with digital addiction. Mindfulness-Based Interventions (MBIs) foster an acute consciousness of the present moment and encourage a non-judgmental acceptance – essential skills in mitigating addictive inclinations. (Witkiewitz et al., 2014). The integration of MBIs into treatment protocols may enhance individuals' ability to navigate the digital landscape mindfully.

C. Neurofeedback and Yoga

Assessments of the behavioural efficacy of Neurofeedback (NF) and physical interventions have yielded contradictory findings. Just like physical exercise, yoga has been purported to enhance neurological, physiological functioning, and behaviour across diverse populations. (Meysam Rezaei et al., 2018).

By leveraging yoga's capacity to enhance self-regulation, emotional resilience, and interoceptive awareness, the research proposes that it may serve as a valuable adjunct to conventional addiction treatment modalities. The comprehensive advantages of practicing yoga, including its impact on mental well-being, physical health, and overall quality of life, are also considered in the context of addiction recovery, aligning with the findings of studies by (Klatte et al., 2016). Elevated concentrations of gamma-aminobutyric acid (GABA) within the thalamus have been correlated with enhanced mood and reduced anxiety levels following sustained engagement in yoga and related exercises (Streeter et al., 2010).

By combining these integrative approaches, clinicians and therapists can offer comprehensive and personalized interventions for individuals grappling with digital addiction. These approaches capitalize on the synergistic benefits of different modalities, addressing the diverse dimensions of addiction and enhancing individuals' capacity for sustainable recovery.

Conclusion:

In light of the escalating prevalence and far-reaching consequences of digital addiction, this review has provided valuable insights into an integrative approach for mitigating its impact. The neural correlates of addiction, shared across various forms of addictive behaviours, highlight the importance of understanding the underlying neurobiology. Yoga emerges as a promising adjunctive intervention, influencing reward processing, enhancing executive functions, and promoting neuroplasticity. Integrative approaches, combining yoga with cognitive-behavioural therapies, mindfulness-based interventions, and neurofeedback techniques, offer a comprehensive strategy for individuals struggling with digital addiction. By targeting diverse dimensions of addiction, these approaches equip individuals with the cognitive and emotional tools needed for sustainable recovery. The findings presented herein underscore the potential of an integrative approach in addressing the complex nature of digital addiction, paving the way for future research and clinical applications in addiction treatment.

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Understanding *bhavnatmak buddhi* (emotional intelligence) through the paradigm of ayurveda

Dr Amrita Sharma¹, Dr Chander Shekhar Sharma²

¹ (BAMS, MD(Ayu.), MBA, NDDY, CFN, YOGA@500hrs) Assist. Professor, Department of Dravyaguna, DAC, Punjab.

² (BAMS, MD(Ayu.), NDDY) Professor & HOD, Department of Kayachikitsa, DAC, Punjab.

Abstract:

Ayurveda is a comprehensive, distinctive *Vedic* science that covers all the facets of health. This ancient science contemplates the state of health as a parameter in equipoise with a healthy mind, intellect, and senses in addition to all physiological parameters. Apart from the physical self, the mental well-being state depicts one's qualified ability to live happily, work fruitfully, and be persuasive. The *Upanishads* describe intelligence (*prajna* or *vijanana*) as the essence of the eternal self, reflected in the body as discernment. According to the *Vedas*, emotional intelligence is also referred to as '*Chitta Shakti*'. The *Vedic* scriptures extensively talk about *buddhi* (intelligence) and its role in health conservation. *Buddhi* (intelligence), the highest aspect of nature in the body, is a crucial component of mental health that illustrates the capacity to change course in various life circumstances. It encompasses the ability to understand, manage, and express emotions effectively. It determines one's ability to see and realize the potential to live in harmony with oneself and others. The paper focuses on understanding the concept of *Bhavnatmak Buddhi* (emotional intelligence), which is a big part of human intelligence that brings creativity and add morals and ethics to the value of life. As per *Ayurveda*, *Bhavnatmak Swasthya*, or emotional health, depends on the state of *Dhee Dhruti* and *Smriti*. These three parameters render the power of *chintyam*, *vicharyam*, *sankalpam*, *uhyam*, and *dhyeyam* that denotes the right perspective on life in terms of thinking, being judgmental, logical reasoning, and fulfilling the goals of life. The concept of life as per *Ayurveda* is the complex combination of *Sharira* (body), *Indriya* (senses), and *Atma* (soul) governed by the *Panchamahabhuta* (five elements). The *Bhavnatmak Buddhi* plays a vital role in different states of the body and mind. Its rational state brings happiness, joy, and the feeling of well-being and health. Its demented state disturbs the three humors (*Vata*, *Pitta*, and *Kapha*) and *Trigunas* (the three qualities of life, viz., *Satva*, *Rajas*, and *Tamas*), in which *Rajas* and *Tamas* dominate. Dominance of *Rajas* and *Tamas* dosha hampers decision-making and results in impairment of memory and emotional imbalance, which arises negative feelings like *Kama* (desire), *Krodha* (anger), *Lobh* (greediness), *Moh* (illusion), *Irshiya* (jealousy), *Mann-Mada* (arrogance), *Shoka* (grief), *Chinta* (worry),

Udvega (anxiety), etc. Ayurveda has a beautiful insight into dealing with the causes and solutions to find how we can curtail these disorders and make our lives happy. According to *Ayurveda*, the concept of mind (*Manas Prakriti*) is comprehensive and significantly generates emotions in life. *Manas prakriti* is considered non-static and changes with the waves of mental thoughts and emotions. It's derived from various components like *Buddhi*, *Ahamkara* (ego), and *Chitta* (consciousness). *Mano doshas* (*rajas* and *tamas*) and *Manas Prakriti* (mental constitution) are responsible for the experiences and interpretations of life that differentiate an individual for the ability to recognize, comprehend, appraise, and use the power of emotions as a source of human inspiration and knowledge and influence one's capability to learn and interact with the environment. With the fast-changing technology-oriented world, health issues related to emotional imbalances are growing rapidly. It has been observed that people with higher emotional intelligence lead a positive quality of life, effectively managing conflicts, being able to navigate relationships and situations, and making decisions guided by wisdom and empathy. People get increasingly better at handling emotions, impulses, and performance with a higher emotional quotient. Thus, emotional intelligence is considered an essential tool for physical health and psycho-spiritual health, while people with low emotional intelligence tend to develop mental, emotional, psychopathological, and spiritual issues in life. Emotional intelligence has been proven to be a resilient factor in mental health. A deficiency of emotional intelligence can have a variety of detrimental psychosocial and physical outcomes for individuals that may require therapeutic intervention from time to time. People with low emotional intelligence suffer from mental disorders, lack of empathy, anxiety, anger, hostility, depression, impulsiveness, vulnerability, weak defense mechanisms of the body, and have problems understanding their emotions more than others. These issues are not new but have existed for a long time. Low emotional intelligence leads to drug and alcohol abuse, bipolar disorder, eating disorders, bulimia, schizophrenia, and substance abuse disorder. *Ayurveda* elaborates on the mental and emotional disturbances leading to psychological disorders such as *Apsmara*, *Unmada*, *Atatvabhinishedha*, *Grahabadha*, etc. As *Ayurveda* is focused on attaining physical and mental well-being, the texts have elaborated various means adapted for the balance of emotions and sustenance of emotional health. These methods include pharmacological and non-pharmacological approaches to cure and balance emotions. Emotional awareness can be evolved from childhood and cultured at later stages of life. Lifestyle management and trends can grossly change the emotional quotient of an individual. *Ayurveda* is among the rare sciences that emphasize lifestyle management to cure many diseases and disorders at the physical level and transform the emotional and spiritual grounds. These parameters are of utmost importance when it comes to emotional health. The paper also highlights the sublime concepts of *Ayurveda* that describe the means to build emotional intelligence. These concepts include *Dinacharya* and *Ritucharya* (daily and seasonal regimens) are the tools that give a glimpse of a disciplined lifestyle and reinforce positive emotional health. *Sadvritta* is another means to follow a good regime in life, in

other words, a good code of conduct that shall be followed in personal, social, religious, and practical dealings, which aids in increasing the mental faculties. *Acharya rasayana* is the rejuvenating attitude that implies moral, ethical, and benevolent conduct, personal and public cleanliness, truth, nonviolence, mental and personal hygiene, devotion, compassion, and a yogic lifestyle. *Medhya rasayana* is a group of nootropic herbs that enhance biological nourishment of the brain, produce tranquility of mind, and improve memory, concentration, emotional health, and intellect. *Satvaavjaya Chikitsa* is a treatment modality designed to increase the sattva. It is achieved through *Jnanam* (knowledge), *Vijnanam* (analytical thinking), *Dhairya* (courage), *Smrti* (memory), and *Dharana* (concentration). Using the *Ayurveda* detoxification technique of *Panchakarma* can be beneficial to restore the normalcy of intellect, sense of faculties, and mind and achieve emotional balance. Treatment through divinity by *Daivavyapashraya Chikitsa*, which is based on the modality of a divine power through *mantra chanting* (enchanted hymns), *Ausadhi* and *Mani dharna* (wearing sacred herbs and precious gems), *Mangala Karma* (propitiatory rites) like *bali* (oblations), *homa* (sacrifice), *Upahara* (offerings), *Niyama* (vows), *Prayascitta* (ceremonial penitence), *Upavasa* (fasts), *Pranipata* (surrender), etc. Tropical application or fumigation of aromatic oils like sandalwood oil, camphor oil, cedar oil, rose oil, jasmine oil, etc. has been proven beneficial to enhance emotional, cognitive, and psychological well-being.

Exploring Plant Consciousness through Anesthesia-Induced Organelle Dynamics

Shilpa Chandra¹, Abdul Salam², Bodhidipra Mukherjee³, Laxmidhar Behera¹, Chayan K Nandi²

¹Indian Knowledge System and Mental Health Applications Centre

² School of Chemical Sciences

³School of Biological Sciences, IIT Mandi, Himachal Pradesh, India

Abstract:

Traditional concepts of consciousness have been associated with animals, particularly humans, involving self-awareness, perception, and responses to environmental stimuli. Recent research challenges these notions by expanding the scope to include plants, which exhibit sensory and adaptive behaviors despite the lack of nervous systems. This study utilizes anesthesia, known for its ability to induce loss of consciousness in animals, as a tool to investigate the concept of plant consciousness. Our principal aim is to identify potential biomarkers linked to consciousness in plant cells, with a particular focus on various organelles. We investigate the changes in organelle arrangement and functionality induced by anesthesia, deepening our insight into plant cellular dynamics.

In this study, anesthesia enhances the visibility of plant nuclei by reducing autofluorescence and disrupting chloroplast development, resulting in decreased chlorophyll accumulation. Additionally, anesthesia modifies the relationship between chloroplasts and nuclei, inducing chloroplast autophagy, which selectively eliminates damaged chloroplasts. Furthermore, anesthesia significantly impacts mitochondria, leading to depolarization, reduced membrane potential, and increased mitophagy, reflecting changes in cellular consciousness. Remarkably, these effects are reversible, highlighting the dynamic nature of these cellular processes. This study advances our understanding of plant consciousness and the underlying mechanisms while demonstrating the potential of anesthesia as a valuable tool for investigating plant consciousness.

Keywords:

Consciousness, Anesthesia, Biomarkers, Plant cellular dynamics, Plant organelles

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Sparsh Bharati: A Braille-like system for Indian Languages

Srinivasa Chakravarthy¹, Sanket Sakar¹, Harshita Jajodia², Bhargav Satya¹,

¹Indian Institute of Technology Madras, Chennai, 600036.

²National Institute of Design, Kurukshetra, 136131.

Abstract:

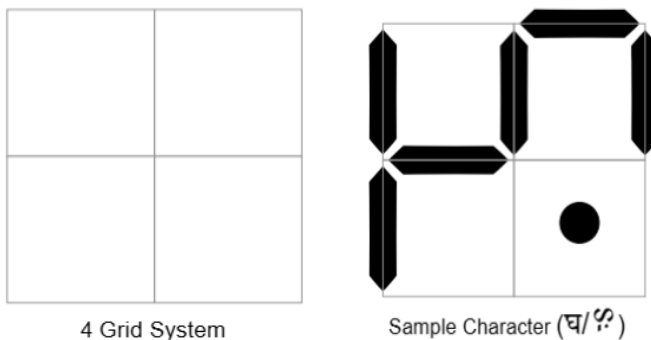
Sparsh Bharati is a Braille-like system that is developed for Indian languages to aid the visually impaired to have a better perception while sensing the characters. Sparsh Bharati originates from the previously developed Bharati script, which was designed to overcome the communication barrier across different regions in India.

Bharati script is a novel script that was proposed as a unified script for Indian languages. It can represent the characters of a majority of contemporary Indian scripts. In order to achieve a level of continuity with existing Indic writing systems, the shapes/motifs of the Bharati characters are drawn from some of the most uncomplicated characters of existing Indic scripts. Bharati characters are designed such that they strictly reflect the underlying phonetic organization, thereby attributing to the script qualities of simplicity, familiarity, ease of acquisition, and use. Sparsh Bharati represents an effort to develop the Bharati script into a Braille-like script. Sparsh Bharati's characters have a straightforward design and better semantics that could be easily perceived by the visually impaired. The existing Braille system for Indic Languages is based on the Western language system. The semantics and characteristics significantly differ in the Indic linguistic system when compared to Western languages. For example, complex letters like (ksh,nga, etc.) and abbreviations like (halant) that are found in Indian Languages have complicated representations in Braille that are difficult to interpret even for a seasoned Braille user. So, an adapted western system of Braille for Indian languages has shown many irregularities while representing the complex characters in the Indic system, which has caused a lot of confusion among the readers. Inspired by the concept of Braille, where the characters are described with raised circular dots within 6 positions, we tested Bharati script characters by 3d printing them on plastic boards as well as on different types of papers. These scripts were then taken to at least a dozen of blind students across different levels of qualification ranging from intermediate to postgraduate at different schools and colleges in Delhi. Thanks to the simple pattern of characters and smooth tactile value, we observed that with a minimal amount of training the blind students were able to memorize and identify different characters quickly. They appreciated the script's rich and textured tactile experience and saw its particularly crucial role in teaching reading and writing to early blind learners unfamiliar with braille. When they flagged the issue of too many curved lines in the script, which could potentially cloud the

memory and readability of the learner, we resorted to a majority of straight lines in our script without losing the rich texture of Indian scripts. They highlighted the issues of uniform spacing among characters and minimizing the size of the characters to fit within the tip of the fingers. Both of these issues are fixed in our newest variant of the script, as the characters were re-designed within a 4-grid system that can be visualized as



In the most recent variant of Sparsh Bharati, the characters are designed with a combination of vertical/horizontal line segments and circular marks that could be represented within the 4-grids. Using the raised vertical/horizontal line segments instead of circular dots could give a better understanding of the structure of characters where the perceiver can have a better vision of characters in the mind and could perceive the script quicker as line segments give a better construction of characters when compared to circular dots.



Sample Characters:

क/ॐ -> 𑖙 म/॑ -> 𑖛 र/ॡ -> 𑖚 ह/ॢ -> 𑖜

This novel design of characters helps the visually impaired have a better representation of characters in mind and a more straightforward cognition while perceiving the characters. For a better understanding and memorization, Sparsh Bharathi characters are designed in such a way that all vowels are represented within the bottom 2-grids (7 segments). At the same time, all consonants can be described within all 4 grids, which makes the individual perceive the script quicker and more accessible by differentiating between consonants and vowels. In conclusion, Sparsh Bharati has the potential to act as an alternative to Braille for Indic Language Scripts.

Understanding Consciousness Through the Lense of Advaita Vedanta in the Context of Quantum Physics

Aheli Chaudhuri¹, Abhishek Das¹, Swarbhanu Bandyopadhyay¹

¹BA Honours, Department of English, Swami Vivekananda University, Kolkata, MA, Department of English, University of Delhi

¹MA, Department of English, Swami Vivekananda University, Kolkata, BA Honours, Department of English, Seth Anandram Jaipuria, University of Calcutta

Abstract:

The universe is all of space and time and it includes planets, stars, galaxies, and all other forms of matter and energy and every object that we perceive to see and identify is at an infinite level a collection of sub-atomic particles spinning in a given probability at a point of time. The probability of these particles of being at a different position is infinite and the probability and other measurements of one particle affect that of all the other particles. Thus, all the particles are part of the same body that is the Universe. Thus, it is understood that this Universe is nonbinary which also meets the concept of Brahman, while anything other than Brahman is considered as ('maya') of Brahman. This awareness of oneness is the consciousness of being which Advaita Vedanta advocates. Consciousness is the knowledge of inner being and external being and this is the point where we have to understand that the existence of free will is the same as an element of consciousness which is a non-deterministic concept itself. According to some renowned scientists, such as Eugene Wigner, John Bell, and later Roger Penrose, consciousness could be determined as a quantum phenomenon which also means even the best classical theories and calculations in regard to quantum experiments are mere probabilities. So, this paper aims to analyse the connection between 'Prajna', which means pure consciousness, and 'mind-body dualism', with quantum physics where this mind-body dualism can be understood with respect to Schrödinger's Cat paradox and consciousness could be understood in terms of a potential quantum consciousness. Every school of Vedanta serves the common idea of relating the individual self ('jiva') and Atman/Brahman. Advaita tradition leads this knowledge through 'svādhyāya' in other words, the study of the self and the Vedic texts. We can say, this knowledge lets us consider ourselves as the self-controlled, well aware, well stabilized human beings with no chance of opposing between self and non self.

Keywords: Consciousness, Advaita Vedanta, Maya, Brahman, Dualism, Prajna, Quantum.

Viewing Indian Knowledge Systems through the Lens of SatSu(Perman) Evolutionary Scheme with Special Focus on Dayalbagh Way of Life

Ms. Chhabi Bhandari¹

¹Prem Vidyalaya Girls Intermediate College, Dayalbagh Educational Institute, Dayalagh, Agra
chhabibhandari18@gmail.com

Abstract:

The study examines the importance of the Indian Knowledge System and its differences from the current education system. The paper further examines the impact of inculcating the Indian Knowledge Systems in today's technologically advanced education system. The paper analyses the impact of the sigma of various knowledge systems on the consciousness and conscience of the children of the SantSu(Perman) evolutionary scheme in Dayalbagh, Agra. It focuses on the behavioural impact on children in the SantSu(Perman) Scheme of being surrounded by nature and flora and fauna while participating in various activities associated with culture and technology. The hypothesis of the paper is, 'The SantSu(Perman) evolutionary scheme in Dayalbagh develops conscience and consciousness in children' and is proved correct. Keywords: Consciousness, Conscience, Indian Knowledge System, SantSu(Perman) Evolutionary Scheme.

Rajyoga Meditation: A Universal Way of Mindfulness

Dr Devi Archana Mohanty¹, Dr Guneet Kaur¹

¹Assistant professor, JIM Ghaziabad

¹Email: devi@jaipuria.edu.in

Abstract:

In the current context of post-Covid society, the level of stress and anxiety seem to be colossally increased. India has been the centre place of consciousness (Prajna) since ages and its philosophies and knowledge system have a proven track record of benefitting the society at large. Meditation is an ancient scientific technique considered to be focusing on tapping the human mind and body for relaxation and psychological well being. It is said to bring certain biochemical and physical changes in the body that can be instrumental in stress reduction (Chalama et al 2014). Rajyoga meditation – which is based on the concept of soul enduring seven qualities of purity, peace, power, love, knowledge and happiness can play a crucial role in the concept of mindfulness and awakening the inner consciousness. This may allow individuals to sustain a happy and positive state of mind reducing the effect of anxiety and stress. Since there is a dearth of research in this area, this research follows an exploratory approach to understand how Rajyoga meditation is useful for achieving mindfulness.

In the VUCA world, the need for meditation, practice of mindfulness has become a prerequisite. While the human race is confronting a period of uncertainty, unpredictability, the need for a careful approach towards a sustainable living has become the need of the hour. Moreover, the onset of COVID-19 pandemic has accelerated the uncertainty in everything leaving people in a state of delusion. For many, the meaning of a healthy, harmonious world has changed; instead the world has turned into an insecure place. The world has become more unpredictable than before. There is a multifold increase in global disconnection, anxiety, and fear of the unknown. Socio-economic and socio-political factors globally hugely influence psychological morbidity from COVID-19. In the light of this the study proposes the practice of Rajyoga technique for normalizing anxiety, restlessness. The study aims to examine the impact of Rajyoga meditation on the human mind which in turn facilitates a higher state of mindfulness. The study is motivated by the belief that understanding the link between meditation and self-regulation can offer valuable insights for improving mental health, well-being, and personal growth, particularly among management students. This empirical research paper explores the effects of Rajyoga meditation on stress management and performance among management students. The study aims to investigate whether the practice of Rajyoga meditation can alleviate stress and improve the academic and personal performance of management students. A narrative analysis approach was employed, including surveys

and interviews, to gather data from a sample of management students. With ecological, economic, and ideological crises occurring alongside COVID-19, this study proposes that the mindfulness technique of Rajyoga emphasizes the value of life, fosters an interconnected world. Management education is renowned for its challenging and demanding nature. Students pursuing management degrees are often exposed to high levels of stress due to academic pressure, competition, and the expectation of performing well. Stress management is crucial for students to maintain their mental and emotional well-being and optimize their academic performance. Rajyoga meditation, a form of spiritual meditation, is known for its stress-reduction and relaxation benefits. Polizzi et al (2020) contend that normalizing anxiety may help and adapting to the new reality with mindfulness, compassion and value-based approaches is beneficial. Management students commonly experience high levels of stress due to a demanding curriculum, tight deadlines, and the need to excel academically.

Advaita Vedanta and the Explanatory Gap in the Hard Problem of Consciousness

Dileep. G¹, Anuj Nandanwar¹, Shubhajit Roy Chowdhury¹

¹iHub and HCI foundation, Indian Institute of Technology Mandi, India

¹School of Computing and Electrical Engineering, Indian Institute of Technology Mandi,
dileepmon2@gmail.com

Abstract:

The exploration of consciousness has long been a source of fascination for humans, attracting the attention of philosophers and scientists who have delved deep into the mind's inner workings to unravel its mysteries. In contemporary philosophy of mind and neuroscience, one central and challenging issue is known as the "hard problem of consciousness," as defined by philosopher David Chalmers. This problem revolves around the quest to understand the reasons and mechanisms behind why the physical processes occurring in the brain give rise to subjective sensations. It seeks to grasp why specific configurations of neurons result in consciousness, which is a distinct challenge compared to what Chalmers refers to as the "easy problems" of consciousness. The easy problems involve uncovering the cognitive and neural mechanisms associated with various conscious functions like perception, memory, and language. In this essay, we will delve into the complexities of the hard problem of consciousness and explore how Advaita Vedanta, a profound philosophical tradition rooted in non-dualism, provides a unique perspective on this perplexing issue. The hard problem of consciousness is a formidable challenge within the philosophy of mind and neuroscience. At its core, it grapples with the profound question of why and how specific arrangements of neurons in the brain give rise to conscious experiences. It delves into the essence of subjective awareness, attempting to understand how a first-person perspective of the world emerges from the physical activities occurring within the brain. While significant progress has been made in identifying the neural correlates of consciousness, which are patterns of brain activity linked to conscious experiences, the fundamental question of how these neural processes generate conscious awareness still needs to be discovered.

Non-Invasive Diabetes Detection Using Breath

Ritu Kapur¹, Yashwant Kumar¹, Swati Sharma¹, Vedant Rastogi, Shivani, Vikrant Kanwar,
Bhupinder Kumar, Arnav Bhavsar¹, Varun Dutt¹

¹Indian Institute of Technology Mandi, Mandi, Himachal Pradesh-175075, India

² All India Institute of Medical Science Bilaspur, Noa, Himachal Pradesh-174001, India

varun@iitmandi.ac.in, drkanwarvikrant@gmail.com

Abstract:

Diabetes is a prevalent metabolic disorder that requires continual blood-sugar monitoring and is often left undiagnosed. However, the existing invasive blood sugar testing methods, such as finger-prick testing, are uncomfortable as they need the user to prick himself for the test. Therefore, we propose a non-invasive diabetes detection method to predict blood sugar using the breath and body vitals of a person. Our diabetes detection device comprises electrochemical sensors to sense volatile organic compounds (VOCs) present in breath. Given a breath sample and the body vitals of a person as input, our device predicts if the person is a diabetic person or not. The prediction is based on a Machine Learning (ML) model trained on a dataset comprising sensor voltages (for breath samples) and body vitals details obtained from 125 patients of a reputed national hospital. To get the best-performing ML algorithm, we experimented with nine state-of-the-art algorithms; AdaBoost generated the best results with an average accuracy of 85.1% when trained on a dataset, thus improving 20.1% over an existing regression technique. Our device provides a cost-effective, non-invasive, and user-friendly method for continuous glucose monitoring and early diabetic screening.

Keywords: Volatile Organic Components, Breath biomarkers, Non-invasive diabetes detection, blood glucose monitoring, digital health, diabetes mellitus, exhaled breath analysis.

1. Introduction

Diabetes, a widespread health issue, results from the body's insulin-related dysfunction, potentially leading to severe complications [1-3]. Existing diagnostic methods, such as invasive blood tests, are inconvenient [4,5]. We present a non-invasive breath-based system leveraging volatile organic compounds (VOCs) affected by diabetes metabolism [6]. Evaluating 125 patient breath samples, the

system accurately distinguished diabetes presence. Our system shows a convenient, accurate, and non-invasive point-of-care diabetes diagnostic tool.

2. Background

Our work explores breath-based analysis as a non-invasive method for glucose monitoring, highlighting its correlation with blood glucose levels and the role of machine learning in enhancing accuracy. Recent advancements in sensor technology [7,8] and breath-based analysis [9-11] have made this approach more viable, yet challenges remain, including efficient power management and data integration with other physiological parameters. Our proposed diabetes detection system leverages various VOCs, a filter, robust power management, and ensemble machine learning (ML) algorithms to enhance diabetes detection, addressing these challenges.

3. Materials and Methods



Fig. 1. Bread-box multi-sensor setup for sensor calibration experiments

The study aims to develop and evaluate DiabeticSense, a low-cost portable diabetes detection device that uses breath samples and body vitals as input to predict diabetes using machine learning models. DiabeticSense includes a sensor array integrated into a soda sipper cup, with sensors (listed in Table 1.) linked to a microcontroller and WiFi-enabled ESP32. The device collects breath samples, processes sensor data, and records body vitals. The collected data is used to train and test various machine-learning models. Ethical approval and informed consent were obtained for the study. We evaluated the performance of our device with nine state-of-the-art ML classification algorithms (viz., Decision Tree, Support Vector, Random Forest, K Nearest Neighbours, Elastic Net, Ridge, Lasso, Logistic Regression, and AdaBoost) by training and testing them on the breath sample feature matrix as discussed earlier, using an 80:20 split for training (80%) and 5-fold cross-validation, reserving the remaining 20% for

testing. Evaluation metrics include Accuracy, F1 score, and ROC curve area to select the best-performing model.

Table 1. List of Sensors used in the device

Sensor Model	VOC's sensitivity	Sensitivity's range (in ppm)
TGS826	VOCs, NH3	30-5000
TGS2610	H2, VOCs	500-10,000
TGS822	VOCs, H2, CO	50-5000
TGS2602	VOCs, NH3, H2S	1-30
TGS2600	H2, VOCs, CO	1-100
TGS2603	NH3, H2S	01-Oct
TGS2620	VOCs, H2	50-5000
MQ138	VOCs	5 - 500
DHT22	Humidity (H) and Temperature (T)	H: 0 - 100 RH, T: -40 - 80 Celsius

4. Results and Discussion

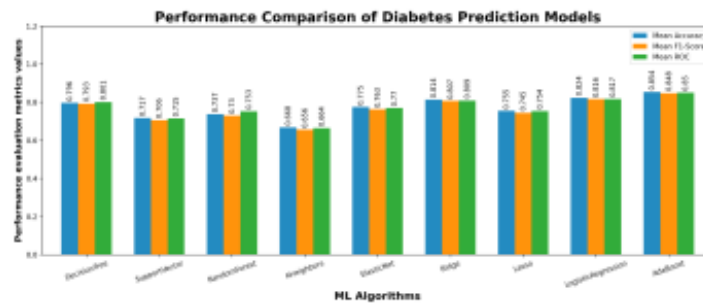


Fig. 2. Performance Comparison of ML algorithms using five-fold cross-validation

As shown in Fig. 2, AdaBoost performs the best of all other state-of-the-art algorithms we experimented with, yielding the highest mean accuracy of 85.1% and achieving an improvement of 20.1% over an existing method [9].

5. Conclusion

To address the global issue of undiagnosed Type 2 diabetes (T2DM), we propose an IoT-based non-invasive system called DiabeticSense. This system, using a patient's breath sample and vital signs, employs MOS-based sensors to differentiate between diabetic and non-diabetic individuals. After

processing 100+ breath samples and training various ML models, we achieved an 85.4% accuracy (and mean accuracy of 85.1%) with the AdaBoost Algorithm. However, there is room for improvement through feature engineering, increased sample size, and additional sensors. We plan to enhance DiabeticSense by adding real-time blood sugar monitoring capabilities and making it more portable. This device has the potential to aid in early diabetes detection, especially in remote areas, and may also be extended for heart disease prediction using breath biomarkers.

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A Comparative Study of Novice and Experienced Meditators: Exploring the effect of Zen Meditation on physiological and psychological parameters

Sakshi Chauhan¹, Sahil Sankhyan¹, Kirti¹, Arnav Bhavsar¹, Varun Dutt¹

¹Indian Institute of Technology Mandi, Mandi, Himachal Pradesh-175075, India

varun@iitmandi.ac.in

1. Introduction

Zen Meditation is a practice suggesting focusing on the breath. This study investigates the differences between novice and experienced meditators regarding behavioral and physiological responses after Zen meditation. By examining these variations, the researchers aim to deepen their understanding of the psycho-physiological effects of Zen meditation. Many researchers have tried exploring Zen meditation [1]; however, our investigation attempted to use a low-cost meditation dedicated device (MUSE-S)[2], multiple questionnaires, and multiple states that led to new revelations. Also, the comparison between experienced versus novice using Muse-S devices.

2. Materials and Methods

The study design encompassed a cross-sectional approach, recruiting a sample of both novice and experienced meditators. The sample size is 36, constituting 12 Experienced, 12 Novice and 12 control groups. Novice participants (n= 12) had no meditation experience, while experienced participants (n = 12) had more than 20 years of consistent meditation experience. Participants were matched for gender and demographic factors to control for potential confounding variables. As a baseline study, the participants were asked to fill out various questionnaires such as Prakriti[3], GAD (for stress analysis)[4], sleep Epworth analysis[5], and meditation-related questions. These questionnaires were crucial in deciding on exclusion and inclusion criteria. The Zen meditation audio was presented to both categories of participants. There were, in total, 9 sessions. These sessions were presented for up to one month, as 3 sessions per week.

3. Results

The experimental comparisons performed have shown some significance regarding time domain factors of HRV, such as Mean RR, Mean HR, NN50, and VLF. Also, we have seen a significant difference in BP compared to both meditators' pre and post-results. The main implications of these results suggest

that, by using Zen meditation, novices could relax themselves as validated by their physiological and psychological parameters.

4. Discussion

The data collection happened pre and post-study. The physiological, behavioral, and psychological parameters were collected during the pre- and post of our study. Behavioral measurements were conducted using standardized cognitive tests to assess attention and concentration. Psychological responses were assessed using self-report questionnaires and physiological measurements to quantify changes in heart rate, blood pressure, and electroencephalography (EEG). Additionally, participants' brain activity was measured using electroencephalography (EEG) during the meditation sessions conducted to investigate the potential differences in neural correlates.

The following comparisons were made to see the changes in the interventions of the experienced meditators and novices:

- Pre-results (EEG, HRV, SPO2, BP) of the experienced meditators versus that of the novice meditators.
- Post-results (EEG, HRV, SPO2, BP) of the experienced meditators versus that of the novice meditators.
- Pre and Post-results (EEG, HRV, SPO2, BP) of the experienced meditators.
- Pre and Post-results (EEG, HRV, SPO2, BP) of the novice meditators.

Keywords: Zen meditation, Electroencephalography (EEG), Blood Pressure, Heart Rate Variability (HRV).

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Exploring the Impact of Rural Indian Lifestyle, Eating Habits, and Exercise on Diabetes: A Survey-Based Study

Swati Sharma¹, Ritu Kapur¹, Shivani¹, Arnav Bhavsar¹, Varun Dutt¹

¹Indian Institute of Technology Mandi, Mandi, Himachal Pradesh-175075, India

varun@iitmandi.ac.in

Abstract:

With a higher prevalence of Diabetes in rural India (9.6% versus 7.4%), there is a need to understand the factors contributing to this trend. A critical knowledge gap exists in unravelling the intricate interplay of lifestyle

choices, socio-cultural influences, and awareness levels specific to rural India. The existing research often focuses on urban populations, leaving a void in our comprehension of the unique dynamics driving the diabetes epidemic in

rural communities. This paper aims to bridge this gap by providing a comprehensive examination of these factors among 100+ individuals residing in rural areas of Himachal Pradesh, India, thus enabling the identification of opportunities for targeted interventions and the development of tailored healthcare approaches specifically tailored to the needs of rural populations. People (58%) having a sedentary lifestyle (44%) and consuming a diet high in processed foods and sugar (67%) were found to be affected by Diabetes. Unawareness (37%), Inaccessible

healthcare (12%), and socio-cultural factors(55%) were significant Diabetes contributors with a substantial correlation value of 0.000007 (i.e., $p < 0.05$ with a confidence interval of 95%). Additionally, the study found that more than 85% of people use traditional Indian knowledge systems, such as Ayurveda (86%) and Yoga (45%), to prevent and manage Diabetes. The findings of this study provide a better understanding of the intricate interplay between rural Indian lifestyle, eating habits, exercise, and Diabetes. The study emphasizes the potential for integrating traditional practices into modern healthcare approaches, fostering a holistic and inclusive approach to diabetes prevention and management.

Keywords: Diabetes, Rural India, Lifestyle, Eating Habits, Exercise, Health, Indian Knowledge Systems, Ayurveda, Yoga.

Social Robots for Mental Health Assessment and Storytelling

Anuj Nandanwar¹, Varun Dutt ²

¹IIT Mandi iHub and HCI Foundation, Kamand, India

²Indian Institute of Technology Mandi, Mandi, Himachal Pradesh-175075, India

varun@iitmandi.ac.in

Abstract:

Integrating social robots into medical and educational assistance represents a transformative frontier in contemporary technology. Social robots, designed for social and emotional interaction with humans, hold promise for various applications despite concerns about privacy and resource limitations. One area where social robots could significantly impact is assessing stress, anxiety, and depression using conversational AI. Traditional paper-and-pencil methods for evaluating these mental disorders can be time-consuming and may not capture the complexity of an individual's emotional state [1]. Another area where social robots can be helpful is storytelling and conversational AI [2-4]. However, an evaluation of social robots in India in such settings for assessing stress, anxiety, and depression, as well as for storytelling, has yet to be discovered. Our first objective was to evaluate mental health assessment using tools like the Depression, Anxiety, and Stress Scale (DASS) [5] through a social robot. DASS was integrated into social robots to create a compassionate support system for improving mental healthcare. The robot administered DASS questionnaires, and participants were divided into experimental and control groups. The experimental group interacted with the social robot, while the control group used traditional methods. In an experiment with 29 participants, t-test analysis was employed to compare both methods. The results showed no significant difference in DASS scores between the robot ($M = 7.14$, $SD = 6.55$) and pencil-and-paper ($M = 8.40$, $SD = 7.97$) methods, $t(26.59) = 0.465$, $p = 0.636$. This indicates that the social robot-based data collection and analysis method is comparable to the traditional paper-and-pencil method. In our second objective, we explored the role of social robots in storytelling for educational purposes. Social robots can provide tailored and engaging storytelling experiences for children. Previous research has shown that young children perceive social robots as companions and educators [6-8]. The robot's credibility as an educator depends on its social behaviours [9]. In this study, the robot narrated a dramatic story to evoke emotions in participants. This feature enhances accessibility and effectiveness. The testing protocol involved two conditions: robot narration and listening to the story from a human teacher. The robot and teacher narrated the story "The Merchant of Venice" in Hindi and English. After the narration, the robot and teacher asked questions and rated the participant's experiences. Twenty participants took part in this study, and t-test analysis revealed no

significant differences in scores between the robot ($M = 14.10$, $SD = 1.52$) and human teacher ($M = 12.00$, $SD = 1.95$) conditions, $t(17.03) = 0.2689$, $p = 0.16$. These findings indicate that social robots can offer accessibility, availability, consistency, reliability, data privacy, and confidentiality for participants. This research provides valuable insights into the evolving landscape of medical and educational assistance, offering a promising glimpse into the future. Future research could examine the long-term effects of social robots on patient and children's outcomes.

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Cross-domain calibration for text reconstruction from non-invasive EEG brain signals

Gaurav Jaswal¹, Arnav Bhavsar², Varun Dutt ²

¹ IIT Mandi iHub and HCI Foundation, Kamand, India

² Indian Institute of Technology Mandi, Mandi, Himachal Pradesh-175075, India

varun@iitmandi.ac.in

Abstract:

State-of-the-art EEG-to-text based BCI systems have achieved moderate success in decoding text directly from brain signals using neural networks [1, 2]. Also, current approaches are limited to building relationships in between EEG and text modeling at the feature representation level [1, 3]. To explore the relationship and dependency between EEG and text [2, 4], i.e., how one domain reflects and represents the other, we first propose a Hierarchical Transformer Calibration Network (HTCMNet) to build corresponding representations between the two modalities, and secondly employ the transformed representations for EEG to text Generation tasks using generative models. The whole process is divided into two sub-tasks: cross domain alignment, and generation. In the first step, we use a dual-encoder architecture, where each module contains hierarchical transformer encoders. The inputs of each encoder are EEG and text (letters or word), respectively. The central idea of using hierarchical encoder is to decouple feature learning and feature abstraction components and then the processed information is aggregated well. This process is repeated in a hierarchical manner, resulting in a pyramid network structure. By feeding EEG as input into its respective hierarchical encoder, we extract transformed EEG embeddings as input for the cross alignment module. While for the text (letter or word) as input to the encoder, the design of the encoder is slightly different from the EEG encoder. Here, the text (in case of ‘words’) is first processed with a pretrained language model (BART) to extract text embedding. The pre-trained BART model is used to lower the computational demands and facilitate the learning process in a less complex space. Then a hierarchical transformer encoder is used to transform the raw text embeddings into high-level features. In order to align the EEG and the text information, we employed two new loss functions (i.e., DCCA and EMD) in addition to the original cross-entropy loss. Compared to CCA, deep learning based CCA makes it possible to learn the feature mapping from data itself. Deep CCA provides a more flexible and robust way to learn and search the nonlinear association between two variables. More specifically, deep CCA first passes the EEG embedding and text embedding through multiple stacked layers of nonlinear transformations. Earth Mover’s Distance (EMD) as the objective function has the ability to align embeddings from different domains. EMD can well serve as

a metric for computing the distance between two distributions of EEG and text. The loss objective for the cross-domain alignment can be formalized as: $\text{Total Loss} = L_{ce} + \alpha L_{dcca} + \beta L_{emd}$. Thus, the alignment module reduces the randomness and sparsity, showing the effectiveness of discovering and encoding the relationship between EEG and language. Later we extract the output from an intermediate layer of the trained cross alignment model as the EEG encoding for classification. In the second step, we propose a Generative Adversarial Network (GAN) to visualize the text which is encoded from EEG signals. A traditional GAN architecture consists of two main components: generator (G) and discriminator (D). A generator is used to generate a sample text-image from a random noise input (z), and the discriminator takes this generated sample as input and determines whether it is a synthesized sample or a real sample. In GAN, the encoded signal is used as conditioning for the generator. The generated text-image is passed to the discriminator for an adversarial loss. We have used hinge loss for stable training of GAN over EEG data which helps the network in learning from small datasets. We performed in-depth experiments and ablation studies over self-collected and public datasets to justify the superiority of our approach.

Comparative Analysis of EEG-Text Alignment

In this study, we adopted the oversampling strategy for data augmentation which ensures a balanced distribution of classes included in each batch. We used two standard dataset and two inhouse datasets for the evaluation. The train/test/validation splitting is as follows- 80%; 10%; 10%. In order to validate our approach on text and EEG data, we have been comparing with State-of-the-art models such as LSTM, Bi-LSTM, Vanilla Transformer, and MLP.

Revisiting Quantum Anomalies: Integrating Consciousness from Bharatiya Perspectives

B. C. Chauhan¹

¹Department of Physics & Astronomical Science,
Central University of Himachal Pradesh (CUHP), Dharamshala, Kangra (HP),
India-176215

Abstract:

Modern science has identified anomalies in matter and light which ultimately led to the conception and development of quantum mechanics. It offered a completely new model of subatomic particles constituting the entire universe that explains the phenomena associated with black-body radiation, the photoelectric effect, the behavior of solids, the structure and function of DNA, super-conductivity, properties of superfluids, and burning of stars etc. Despite extraordinary successes, quantum theory faces conceptual challenges; e.g. reduction to a single eigenstate from a superposition state, measurement problem, quantum entanglement, and uncertainty principle, etc. In fact, all the modern scientific theories (classical and quantum) treat the observer as a separate entity i.e. something quite independent of the observational universe. However, the observer is a conscious being, which makes perception possible, and enables one to accept or refute the phenomenon. This indicates a big flaw in the foundation of the modern scientific paradigm. Therefore, the conceptual difficulties of quantum theory have invited the role of the observer (human mind) in the definition of reality i.e. in the fundamental understanding of nature. In this lecture, I will discuss these details and explore the potential solution, which can be offered by the Bharatiya knowledge systems. It is highlighted that Bharatiya thoughts advocate the key role of consciousness in the act of observation. Although this would be a great challenge to include the factor of consciousness in modern scientific contemplation, yet once done can lead the future course of science. Some annotations have been included in the presentation.

Impact of Integrated Yoga Therapy On Cognitive Function In Breast Cancer Patients Undergoing Chemotherapy: A Randomised Controlled Study

Ganagarajan Inbaraj¹, Raghavendra M Rao², Kaviraja Udupa¹, Amritanshu Ram³, Jamuna Rajeswaran⁴, Krishna Nandakumar³, Spoorthi Belur³, Ramajayam Govindaraj¹, Akhil Rajeev⁴, Prathyusha V⁵, Talakad N Sathyaprabha¹

¹Dept of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bangalore,

²Director, Central Council for Research in Yoga and Naturopathy, New Delhi, India

³Dept of Complementary and Alternative Medicine, HCG Hospitals, Bangalore, India

Abstract:

Breast cancer is one of the most common malignancies affecting women worldwide, with numerous patients undergoing chemotherapy as a primary or adjuvant form of treatment [1]. While chemotherapy is an essential tool in the battle against breast cancer, its systemic nature can affect various physiological and psychological aspects of a patient's health. One of the less frequently highlighted yet substantial adverse effects of chemotherapy is its impact on cognitive function, commonly referred to as 'chemobrain' or chemotherapy-induced cognitive impairment (CICI) [2]. CICI can manifest as deficits in memory, attention, executive function, and processing speed, leading to decreased quality of life, diminished daily functionality, and heightened emotional distress [3].

Given the increased survivorship rates among breast cancer patients, there is an insistent need to address these post-treatment cognitive challenges. Yoga, as an ancient practice, has been documented for its myriad health benefits, including its impact on mental clarity, stress reduction, and overall cognitive enhancement [4][5]. In particular, yoga therapy, a more tailored and therapeutic application of yoga, has shown promise in various clinical settings.

However, the systematic study of yoga therapy's efficacy, specifically in ameliorating CICI among breast cancer patients, remains relatively nascent. This research aims to bridge this knowledge gap by conducting an 18-week integrated yoga therapy program to evaluate its potential benefits on cognition in breast cancer patients undergoing chemotherapy.

Methods:

A total of 150 women diagnosed with stage I-III (non-metastatic) breast cancer participated in the study. These participants were randomly allocated into two distinct groups: the Treatment as Usual (TAU)

group, and the Treatment as Usual with Yoga Therapy (TAUYT) group. All participants were scheduled to undergo six cycles of adjuvant chemotherapy, with each cycle spanning 21 days. Specific inclusion and exclusion criteria determined eligibility for participation.

Participants in the TAUYT group received integrated yoga therapy sessions comprising physical postures, breathing exercises, meditative practices, and relaxation techniques five days a week for 18 consecutive weeks during their chemotherapy treatment. Meanwhile, the TAU group received only the usual care without any yoga intervention. To gain insights into the cognitive function of each participant, a comprehensive neuropsychological test battery was administered before and after the completion of the six chemotherapy cycles. This battery incorporated seven key tests. These were: the Rey Auditory Verbal Learning Test, which evaluates verbal learning and memory; the Visual Reproduction task, focusing on visual learning and memory; the Digit Span Test, measuring memory and recall capabilities; the Digit-Symbol Substitution Task, aimed at gauging processing speed; the Tower of London test, assessing planning and executive functioning; the Colour Trials Test conditions 1&2, focused on attention; and finally, the Stroop Test, which evaluates executive functioning. A two-way Repeated Measures ANOVA was used for normally distributed data to determine the Time*Group interaction. For skewed data, the Wilcoxon rank test compared within group changes and the Mann-Whitney U-test evaluated differences between-groups.

Results:

Our study elucidated the differential effects of Integrated Yoga Therapy (IYT) on cognitive functions among breast cancer patients undergoing chemotherapy. Specifically, in the RAVLT - Long-Term Percent Retention (LTPR%), the yoga group displayed an increase from 76.87% to 80.49%, while the control group saw a decrease from 73.99% to 68.55%, suggesting that IYT potentially aids in bolstering verbal memory performance, essential for daily communication. In the Color Trails Test (CTT) Conditions 1 & 2, the yoga group demonstrated an enhanced attention and task-switching ability, with time taken to complete the shifting from 72.77 sec to 63.05 sec in Condition 1 and 155.12 sec to 136.07 sec in Condition 2, while the control group's scores increased. The Stroop Effect further solidified the potential benefits of IYT on executive functioning with the yoga group's scores decreasing from 54.73 to 49.35 and the control group's scores increasing from 60.43 to 75.31. Remarkably, in Visual Reproduction, the yoga group's visual retention increased from 70.66% to 84.5%, whereas the control group dropped from 74.1% to 67.2%. The Tower of London Task (TOL) results were significant, with the yoga group's problem solving performance surging from 9.71 to 11.57, and the control group dropping from 10.17 to 8.11. For the Digit Symbol Substitution Task (DSST), the yoga group completed the entire task from 328.1 sec to 298.76 sec, while the control group increased from 323.55 sec to 364.52 sec. This highlights the impact of yoga on processing speed and the varying potential of yoga as a

therapeutic tool. Finally, in the Digit Span Forward & Backward, the yoga group showcased an improvement in short-term memory and working memory, with digits progressing from 7.89 to 9.68 in the forward task and 5.99 to 7.49 in the backward task, while the control group regressed in both (Table 1 and 2). These results highlight the potential therapeutic value of IYT in mitigating cognitive challenges in chemotherapy patients. Integrating IYT into treatment regimens might enhance patients' cognitive health outcomes and overall quality of life.

Discussion

The findings suggest a protective and possibly restorative effect of IYT on cognitive functions in breast cancer patients undergoing chemotherapy. In particular, the yoga group showed improvement in tasks related to attention, as evidenced by the Color Trails Test; processing speed as evidenced by the DSST, and executive functioning as demonstrated by the Stroop Effect. In contrast, the control group showed a decline. Notably, the Rey Auditory Verbal Learning Test and the Tower of London Task results emphasize the potential benefits of yoga in memory and planning domains, respectively.

The mechanism through which yoga confers these benefits remains an area for further exploration. Speculatively, the relaxation and mindfulness components of yoga may aid in stress reduction, potentially mitigating the inflammatory processes associated with cognitive decline. Moreover, yoga's focus on coordinated movement and breath might stimulate brain regions linked to attention and memory.

Conclusion:

Integrated Yoga Therapy, when administered alongside conventional chemotherapy treatment, appears to have protective effects on cognitive function in breast cancer patients. The potential to not just maintain but also enhance cognitive functions during chemotherapy signifies a significant breakthrough. These findings have essential implications for enhancing the quality of life for patients undergoing chemotherapy. Future studies with larger samples and varied cancer types might further elucidate the role of yoga as a valuable adjunct therapy during cancer treatments.

Development and content validation of a Yoga-based spiritual well-being scale

Praerna Chowdhury¹, Ramajayam G², Arun Sasidharan¹, Ravindra PN¹, Bindu M Kutty¹

¹Centre for Consciousness Studies, Department of Neurophysiology, National Institute of Mental Health and Neurosciences, Bangalore, Karnataka

²Indian Knowledge System & Mental Health Applications centre (IKSMHA),

²Indian Institute of Technology, Mandi, Himachal Pradesh

* Corresponding author

praernabhargav@gmail.com

Abstract:

Well-being refers to experiencing positive state of health and vitality arising from thoughts, emotions, actions, and experiences. It encompasses quality of life as well as the ability to contribute to the world with a sense of meaning and purpose to lead a satisfying and meaningful life. Well-being is a multi-dimensional construct and most of the existing well-being scales are deficient in assessing well-being in a holistic way. The evolving science of well-being recommends focusing on flourishing domain that ascertains building inherent human assets to tap well-being both as an individual and as a society. This study attempted to develop a yoga-based generic well-being scale, targeting implicit human assets - positive attitude and action based on inner powers integral in classical Yogic texts and taught in Brahmakumaris Raja yoga meditation tradition. Ten experts from Raja yoga meditation tradition with substantial educational background validated the scale. The initial list contained 70 items and the experts agreed with most of the scale items. After content validation and incorporating the modifications & suggestions made by the experts, the final scale comprised of 45 items. In future, construct validity of these scale items will be tested with data from meditators and non-meditators. This scale assesses all the basic components of one's well-being – coping mechanism, overall thriving and sustainability. Being holistic, this scale may prove to be a potential measure of both assessing as well as motivation to enhance well-being.

Keywords: Yogic inner powers, Brahmakumaris Raja yoga meditation, Holistic well-being scale

1. Introduction

1.1 Well-being – meaning and dimensions

Well-being refers to experiencing positive state of health and vitality arising from thoughts, emotions, actions, and experiences. It encompasses quality of life as well as the ability to contribute to the world with a sense of meaning and purpose to lead a satisfying and meaningful life [1,2].

Substantial studies have made efforts to assess well-being, especially with respect to two major domains – Hedonic or subjective well-being and Eudaimonic or psychological well-being. In simple terms, Hedonia refers to feelings [3] i.e. maximizing happiness and reducing pain that ultimately results in pleasure, contentment and satisfaction [4]. Whereas Eudaimonia refers to functioning [3], i.e. to have meaning and purpose in life and live a self-concordant life [5]. It has been observed that well-being is connected to success at professional, personal, and interpersonal levels, manifesting as greater productivity at workplace, better resilience, more effective learning, increased creativity, good physical health, more prosocial behaviours, and positive relationships [3,6,7]. Last few decades have witnessed development of a number of scales that measure one or some of the aspects of well-being [8,9]. However, in view of the multidimensional aspects of well-being, recent studies have reported the inadequacy of the existing well-being assessment scales, necessitating inclusion of both the major components of well-being for proper assessment [3,10]. Recent studies have evolved to attempt assessment of well-being through multidimensional approach using some of the key features from both hedonic as well as eudaimonic perspective and have found some success as well [3,11]. However, there is a need to have a universal approach. Keeping this in mind, targeting implicit human assets - positive attitude and action may pave the appropriate way of both assessing and encouraging well-being [7].

1.2 Inner powers - measure of well-being

In present study, we propose a measure to assess yoga based well-being that is more comprehensive and includes components from both hedonic and eudaimonic approach. It involves balance between the feelings and the functioning [7] and includes measures that assesses one's coping mechanism as well as how well one can thrive in any situation. To achieve such holistic well-being one needs to exercise inner powers both at personal as well as interpersonal levels.

1.3 Inner powers - Traditional reference

Various classical Yogic texts like Bhagawad Gita, Patanjali Yoga Sutra, Yoga Vasishtha etc. cites such inner powers at different contexts. For example, in Bhagawad Gita, when Arjuna is perplexed regarding his duty and finds his inability to discriminate between right and wrong, doable from non-doable and asks Lord to guide him for right understanding [BG 1.30:46, 2:4:8]. Then God reminds him of his honoured stature and inspires him to face the situation bravely instead of becoming a cowardice. He further advocates tolerance for pleasure and pain, heat and cold highlighting their transient nature [BG 2.14:15, 25:28]. Further, he also explains him about how to discern based on true knowledge [BG

2.16:24] and thus facilitates him in making right decision [BG 2.47:52]. In the context of yoga in second chapter, when Arjuna enquires about the features of a man with steady wisdom God has described end results of using having control over the senses [BG 2.58, 61, 64, 68, 70:72] as well as lacking the same [BG 2. 60, 62:63, 66:67]. In addition, God advises to withdraw from sensory indulgences as they lead to destruction of knowledge and hampers realization ultimately impeding one's own way [BG 3.34, 40:41]. While propagating karma yoga in third chapter, God has devised co-operation as in saying – the whole world is bound by action and co-exist with sacrifices [BG 3.9:15]. In addition, he conveys that wise should perform action unattached and accommodate others as well by preventing from unsettling the faith of the ignorant or dull-witted people who are attached to work [BG 3.26, 29]. At another place, God tells, people who look equally upon a well-wisher or an enemy, a neutral or an arbiter, a good person or a sinful one, always excel [BG 5.9]. God also talks at various places about Letting-go, that has to do with engrossing in the self and be ever-content as well as free even while engaged in actions [BG 3.17:18, 4.20:23, 5.7:11, 20:21] [12].

Patanjali in Yoga sutra advocates knowledge of atman as the discriminatory knowledge to discern truth and thus overcome ignorance [PYS 2.26]. Patanjali advises to let go of distracting thoughts and cultivate the opposite ones in order to get rid of obstacles in the path of yoga [PYS 2.33:34]. The eight limbs of yoga proposed by Patanjali involves application & culturing of various inner powers. For example when one decides to follow the path of yoga and undergoes practice of austerity, self-study and devotion to God, he in turn incurs pious outcomes as acquiring various physical and psychic powers, visions of God and ultimate absorption respectively [PYS 2.26]. Then practice of acquiring a physical posture and maintaining the same requires tolerating the bodily natural tendencies, which leads to transcendence of dualities posed by sensual experiences [PYS 2.47:48]. Another tool in the path of yoga called as Pratyahara involves withdrawal from sense objects that result in attainment of mastery over the senses [PYS 2.54:55] [13].

Similarly, in Yoga Vasishtha, first chapter portrays the dejected state of Sri Rama, who through his subtle intelligence and withdrawal from the world around [YV 1.11:12, 19:20] realizes the pain in different stages of life and its transitory nature full of sorrow [YV 1.25:63]. Therefore, he asks revered sage Vishvamitra to tell about the means to attain freedom from sorrow. Vishvamitra after hearing him, praises him for his ultimate discrimination [YV 2.4]. Just like Patanjali, sage Vasishtha while conversing with Rama proclaims two types of mental impressions – good and bad that needs to be overcome. The bad ones should be overcome by making effort to transform bad into good or letting go of them and holding onto only the good ones [YV 2.27:31]. Further second chapter talks about display of tolerance by Shuka at Janaka's palace, where he was treated with disregard and was made to wait for a long period and on top of this fostered to stay in an environment not suitable for him. However, despite

all the adversities, he could maintain his composure and purity of mind, which ultimately led Janaka to bow down to him and cater to his queries [YV 2.9:12] [14].

1.4 Eight Inner Powers

With a glance of inner powers integral in the traditional classical yogic texts, we took the inner powers preached by Rajayoga tradition of Prajapita Brahamakumaris Ishwariya Vishwavidyalaya [15]. They advocate major eight powers (meaning - require strength for execution) that further belong to two categories – execution of power at the personal level and at the interpersonal level. Although both needs exercising power within the self, but the interpersonal level demands expression of power while dealing with others. They are as follows:

Personal: Discern, Decide, Mastery over senses and Let-go

Interpersonal: Co-operate, Face, Tolerate and Accommodate

1. *Power to discern* - ability to discern the subtle, and separate what is true from what is false.
2. *Power to decide* - ability to assess the quality of choices, decisions and actions in yourself and in others.
3. *Power of mastery over the senses (including subtle sense - mind)* - ability to step back and disengage from the world around in order to regain inner strength and prepare oneself in times of difficulties
4. *Power to let-go* - ability to bring things to an end and to stop wasteful thinking
5. *Power to co-operate* - ability to give attention, time, experience and wisdom in the service of others and to work alongside them.
6. *Power to face* - ability to confront and resolve external and internal obstacles, tests and challenges with positivity.
7. *Power to tolerate* - ability to respond to any external and internal events positively, without getting affected by them.
8. *Power to accommodate* - ability to expand and accept the presence, ideas and desires of others even if they appear to be opposite or different from us.

All the measures of different powers can assess one's well-being in terms of their coping mechanism, capacity to thrive well in any life situation and ultimate feeling of satisfaction and contentment. Therefore, this study aimed to develop a scale based on eight yogic inner powers and validate the same with opinion from different adept Raja yoga practitioners.

2 Methodology

2.1 Development of the scale items

In order to develop a scale for assessment of yoga-based well-being, we reviewed the classical yogic texts like Bhagawad Gita, Yoga sutras of Patanjali, Yoga Vasishtha to find the relevant content and reference. Then the description of eight inner powers mentioned in teachings of Raja yoga meditation by Prajapita Brahamakumaris Ishwariya Vishwavidyalaya [15] was compared with the content found

in the contemporary classical texts. As all the texts elicited most of these powers, especially Bhagawad Gita, where references for all the eight powers was found. So all of these eight inner powers were retained in the scale. Further, based on the understanding of each inner power from the references mentioned, several items to measure each inner power were developed. Thus, a list of 70 items was developed for the well-being scale with 7 to 11 items for measuring each inner power.

2.2 Content validation of the scale items

The scale developed was sent to 30 adept Raja yoga practitioners, 10 of whom responded with their scores and comments. The experts rated the usefulness of the items on a scale of 1–5 (1 – Not appropriate, 2 - Least appropriate, 3 – Somewhat appropriate, 4 – Appropriate, 5 – Most appropriate). Content validity ratio (CVR) for suitability of items were calculated. Dichotomous (yes/no) and qualitative responses were also obtained from the experts to determine the appropriateness of each item and all the items as a whole.

3 Statistical analysis

Lawshe's CVR [16] was calculated for each item in the module. Items with a CVR of 0.6 or more were considered beyond chance agreement ($p < 0.05$, one tailed) for 10 raters. Hence a CVR of score ≥ 0.6 was kept as cut off for item retention, with some exceptions as detailed in the results section.

4 Results

Ten adept Raja yoga practitioners (seven males) with 13 – 33 years of experience of practicing Raja yoga meditation (Mean: 22 ± 7.4 years) consented to do the content validation of the scale. Their age ranged from 42 – 72 years with a mean age of 52.6 ± 8.92 years. The experts belonged to different states of India with an average education of 17.9 ± 8.92 years (range 15 – 24 years).

Table 1 shows the scores obtained from experts for individual items as well as the calculated CVR. We retained all the items with CVR score ≥ 0.6 as it is or with rephrasing (10, 11, 18, 19, 26, 32, 34, 39, 42, 45, 49, 50, 63, 69) suggested by experts. All the items with CVR score ≤ 0.6 were removed.

Table 1. Scores from experts and CVR score for individual items of scale to assess yoga-based well-being

S. No.	Measures of Inner power	Power	Score given by experts (No. of experts)	No. of expert rating ≥ 3 (%)	Content validity	Item in the final list	Remarks	Items modified/replaced
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										ty ra ti o			
1	I have the courage to face the life challenges	Face	No response (0)	1 (0)	2 (0)	3(1)	4(1)	5(8)	10(100)	1	Retained		
2 [#]	I usually run away from the life problems	Face	No response (0)	1 (2)	2(0)	3(1)	4(2)	5(5)	8(80)	0.6	Removed	Repetition	
3	Life problems are very challenging and I get scared	Face	No response (3)	1 (1)	2(1)	3(1)	4(0)	5(4)	5(50)	0	Removed	Repetition	
4*	I get anxious and crippled by the challenges	Face	No response (3)	1 (1)	2(1)	3(1)	4(0)	5(4)	5(50)	0	Retained	Rephrased	I get anxious by the challenges, but never get crippled by it
5	I try my best to face the challenges	Face	No response (0)	1 (0)	2(0)	3(3)	4(2)	5(5)	10(100)	1	Retained		
6	I welcome challenges as I always learn something new	Face	No response (0)	1 (0)	2(1)	3(0)	4(1)	5(8)	9(90)	0.8	Retained		
7 [#]	Challenges push me to move to a higher level, I	Face	No response (0)	1 (0)	2(0)	3(1)	4(1)	5(8)	10(100)	1	Removed	Repetition	

	enjoy facing them												
8 [#]	Challenges remind me to update my life skills, so I don't run away	Face	No response (1)	1 (0)	2(1)	3(0)	4(3)	5(5)	8(80)	0.6	Removed	Repetition	
9 [#]	I try to find solution when faced by a challenging situation rather than brooding over it	Face	No response (0)	1 (0)	2(2)	3(1)	4(1)	5(6)	8(80)	0.6	Removed	Repetition	
10	I co-operate with my colleagues naturally	Co-operate	No response (0)	1 (0)	2(0)	3(0)	4(2)	5(8)	10(100)	1	Retained	Rephrased	I co-operate with my superiors and juniors more naturally than peers
11	I co-operate with my family members in all ways possible	Co-operate	No response (0)	1 (0)	2(0)	3(0)	4(3)	5(7)	10(100)	1	Retained	Rephrased	I co-operate with all (family, friends, colleagues) naturally
12 [#]	I don't co-operate unless others co-operate with me	Co-operate	No response (0)	1 (0)	2(1)	3(2)	4(1)	5(6)	9(90)	0.6	Removed	Repetition	

13 #	I often get jealous of others growth and don't co-operate	Co-operate	No response (0)	1 (1)	2(1)	3(0)	4(3)	5(5)	8(80)	0.6	Removed	Repetition	
14 *	I judge people and co-operate selectively	Co-operate	No response (0)	1 (1)	2(2)	3(1)	4(1)	5(5)	7(70)	0.4	Retained	Rephrased	I co-operate selectively based on the fulfilment of my expectations
15	I extend my co-operation with all, irrespective of their co-operation with me	Co-operate	No response (0)	1 (0)	2(0)	3(0)	4(1)	5(9)	10(100)	1	Retained		
16	I focus only on getting my things done and do not bother to co-operate with others	Co-operate	No response (0)	1 (2)	2(1)	3(0)	4(1)	5(6)	7(70)	0.4	Removed	Repetition	
17 #	"What I give I get back", I believe in this and co-operate with everyone	Co-operate	No response (0)	1 (0)	2(2)	3(1)	4(2)	5(5)	8(80)	0.6	Removed	Repetition	
18	I co-operate with friends, family & colleagues considering it as	Co-operate	No response (1)	1 (0)	2(0)	3(4)	4(0)	5(5)	9(90)	0.8	Retained	Rephrased	I co-operate for the sake of duty

	my duty and not naturally												
19	I get irritated for simple things	Tolerate	No response (0)	1 (0)	2(0)	3(1)	4(4)	5(5)	10(100)	1	Retained	Rephrased	I get irritated for simple reasons
20	I can't tolerate others mistakes	Tolerate	No response (2)	1 (1)	2(1)	3(0)	4(0)	5(6)	6(60)	0.2	Removed	Repetition	
21	People don't get along easily with me, as I get irritated often	Tolerate	No response (4)	1 (1)	2(1)	3(0)	4(1)	5(3)	4(40)	-0.2	Removed	Repetition	
22	I get disturbed by people and situations, but I tolerate and manage	Tolerate	No response (1)	1 (0)	2(1)	3(3)	4(0)	5(5)	8(80)	0.6	Retained		
23	I value others' viewpoints and tolerate accordingly	Tolerate	No response (0)	1 (0)	2(0)	3(2)	4(3)	5(5)	10(100)	1	Retained		
24	I appreciate the variety in perspectives of people and value them	Tolerate	No response (1)	1 (0)	2(0)	3(1)	4(3)	5(5)	9(90)	0.8	Retained		
25 #	I understand the significance of teamwork and	Tolerate	No response (0)	1 (0)	2(1)	3(3)	4(1)	5(5)	9(90)	0.8	Removed	Repetition	

	tolerate as per the situation												
26	I am able to tolerate discomfort whether externally or internally without losing inner balance	Tolerate	No response (1)	1 (0)	2(1)	3(1)	4(2)	5(5)	8(80)	0.6	Retained	Rephrased	I am able to tolerate discomfort without losing inner balance
27	I tolerate situations or people at the moment, but lash out later	Accommodate	No response (3)	1 (0)	2(3)	3(0)	4(0)	5(4)	4(40)	- 0.2	Removed	Inappropriate	
28	I understand the larger perspective and transform negativity into positivity	Accommodate	No response (1)	1 (0)	2(0)	3(0)	4(4)	5(5)	9(90)	0.8	Retained		
29	I tolerate situations or people, but get myself heavy in the long run	Accommodate	No response (3)	1 (0)	2(3)	3(1)	4(0)	5(3)	4(40)	- 0.2	Removed	Repetition	
30	Though I understand situation and people and	Accommodate	No response (2)	1 (0)	2(1)	3(3)	4(2)	5(2)	7(70)	0.4	Removed	Repetition	

	tolerate but not naturally												
31	As I keep tolerating situation and people, I get more and more irritated later	Accommodate	No response (2)	1 (0)	2(3)	3(2)	4(0)	5(3)	5(50)	0	Removed	Repetition	
32	I appreciate others strength and weakness and give them the space and support to grow and be positive	Accommodate	No response (2)	1 (0)	2(0)	3(0)	4(1)	5(7)	8(80)	0.6	Retained	Rephrased	I am able to provide necessary space and support for other's growth
33	I appreciate the goodness in everything and keep myself positive irrespective of tough situations & people	Accommodate	No response (2)	1 (0)	2(0)	3(0)	4(4)	5(4)	8(80)	0.6	Retained	Rephrased	I appreciate the goodness in everything and keep myself positive
34	I am able to accept the ideas, expression of others even if they seem to be opposite and different from mine	Accommodate	No response (1)	1 (0)	2(0)	3(1)	4(3)	5(5)	9(90)	0.8	Retained	Rephrased	I am able to accept the ideas, expression of others even if they seem contradictory to mine

35	I understand problems before it becomes too late	Discriminate	No response (1)	1 (1)	2(3)	3(0)	4(2)	5(3)	5(50)	0	Removed	Repetition	
36	I am capable enough to delineate what is sustainable from what is not	Discriminate	No response (1)	1 (0)	2(0)	3(1)	4(2)	5(6)	9(90)	0.8	Retained		
37	I am good enough to distinguish what is best and worst for me	Discriminate	No response (0)	1 (0)	2(0)	3(0)	4(2)	5(8)	10(100)	1	Retained		
38	I lack clarity in identifying issues at the beginning itself	Discriminate	No response (0)	1 (1)	2(0)	3(0)	4(4)	5(5)	9(90)	0.8	Retained		
39	I feel the pulse of people and do justice for what is required for them	Discriminate	No response (0)	1 (0)	2(0)	3(0)	4(7)	5(3)	10(100)	1	Retained	Rephrased	I feel the pulse of people and do justice by doing the needful
40	I just go with the flow, as I am poor in distinguishing right and wrong/best and waste for me	Discriminate	No response (1)	1 (2)	2(0)	3(0)	4(2)	5(5)	7(70)	0.4	Removed	Repetition	

41	Irrespective of the subtlety of situations, I have the mastery to spot the issues at the root	Discriminate	No response (0)	1 (1)	2(3)	3(0)	4(1)	5(5)	6(60)	0.2	Removed	Repetition	
42	I often get confused and loose the capacity to decide	Decide	No response(1)	1 (0)	2(1)	3(0)	4(3)	5(5)	8(80)	0.6	Retained	Rephrased	I often get confused and become indecisive
43	I understand the importance of certain key decisions, but don't have the power to decide	Decide	No response (0)	1 (0)	2(2)	3(2)	4(1)	5(5)	8(80)	0.6	Retained		
44	I often depend on others' opinion to decide most of the things in my life	Decide	No response (0)	1 (0)	2(0)	3(2)	4(2)	5(6)	10(100)	1	Retained		
45	Often I decide impulsively, only to regret later that I should not have decided so	Decide	No response (0)	1 (1)	2(1)	3(1)	4(1)	5(6)	8(80)	0.6	Retained	Rephrased	Often I decide impulsively and regret later
46	I just let things happen randomly in my	Decide	No response (0)	1 (1)	2(3)	3(0)	4(2)	5(4)	6(60)	0.2	Removed	Repetition	

	life; I don't bother about anything												
47	I take timely decisions accurately	Decide	No response (0)	1 (0)	2(0)	3(1)	4(1)	5(8)	10(100)	1	Retained		
48 #	I do take right decisions but not in time	Decide	No response (0)	1 (0)	2(1)	3(0)	4(4)	5(5)	9(90)	0.8	Removed	Repetition	
49	I am good at identifying the underlying intentions of choices, decisions and actions made by self or others and thus decide appropriately	Decide	No response (1)	1 (0)	2(1)	3(1)	4(2)	5(5)	8(80)	0.6	Retained	Rephrased	I decide appropriately considering the needs and intentions of self and others
50	As actively I involve in giving suggestions, I disengage promptly once my turn is over	Mastery oversenses	No response (1)	1 (0)	2(0)	3(1)	4(1)	5(7)	9(90)	0.8	Retained	Rephrased	As much as I give proactive suggestions, I disengage promptly once my turn is over
51	I often get carried away easily by sensory temptations	Mastery oversenses	No response (0)	1 (0)	2(1)	3(0)	4(2)	5(7)	9(90)	0.8	Retained		

52	I allow my mind to think freely or to be in silence as and when required	Mastery over senses	No response (0)	1 (0)	2(1)	3(0)	4(4)	5(5)	9(90)	0.8	Retained		
53 #	Often my mind goes wild and it gets out of control	Mastery over senses	No response (0)	1 (1)	2(1)	3(1)	4(3)	5(4)	8(80)	0.6	Removed	Repetition	
54 #	Either I overdo or underdo whatever is required, but never engage and disengage accurately	Mastery over senses	No response (0)	1 (0)	2(2)	3(0)	4(4)	5(4)	8(80)	0.6	Removed	Repetition	
55	Often I go off the task and later realise the waste of time	Mastery over senses	No response (1)	1 (1)	2(2)	3(2)	4(2)	5(2)	6(60)	0.2	Removed	Repetition	
56	My senses are under my control and I use them as a master	Mastery over senses	No response (0)	1 (0)	2(0)	3(0)	4(0)	5(10)	10(100)	1	Retained		
57	In challenging times, I am not able to figure out things and tend	Mastery over	No response (0)	1 (1)	2(3)	3(1)	4(0)	5(5)	6(60)	0.2	Removed	Repetition	

	to lose my control over myself	sense											
58 *	I am impatient and cannot stop my reactivity when faced with distressful thoughts or situations	Mastery over senses	No response (0)	1 (2)	2(1)	3(1)	4(0)	5(6)	7(70)	0.4	Retained	Rephrased	I am impatient and become reactive when faced with distressful thoughts or situations
59 *	I often get influenced by others thoughts, behaviours and actions	Mastery over senses	No response (1)	1 (3)	2(0)	3(1)	4(1)	5(4)	6(60)	0.2	Retained		
60 #	I live most of the times rewinding my past and feel heavy	Let-go	No response (0)	1 (1)	2(0)	3(0)	4(2)	5(7)	9(90)	0.8	Removed	Repetition	
61	I am able to let go of the past and hold nothing of it in the heart	Let-go	No response (0)	1 (0)	2(0)	3(0)	4(3)	5(7)	10(100)	1	Retained		
62	I sort out my everyday issues then and there and remain light	Let-go	No response (0)	1 (0)	2(0)	3(0)	4(3)	5(7)	10(100)	1	Retained		
63	I learn from the past but live in the present	Let-go	No response (0)	1 (0)	2(0)	3(0)	4(4)	5(6)	10(100)	1	Retained	Rephrased	I focus on living in the

													present moment
64	I get overloaded with future plans and become anxious	Let-go	No response (0)	1 (0)	2(2)	3(0)	4(2)	5(6)	8(80)	0.6	Retained		
65	I live either in past or in future, but very rarely in the present	Let-go	No response (2)	1 (1)	2(1)	3(0)	4(0)	5(6)	6(60)	0.2	Removed	Repetition	
66 #	Learning from the past and with proper future plans, I enjoy the journey of life by anchoring in the present moment	Let-go	No response (2)	1 (0)	2(0)	3(0)	4(1)	5(7)	8(80)	0.6	Removed	Repetition	
67	Irrespective of the past and future I enjoy the present moment	Let-go	No response (3)	1 (0)	2(0)	3(0)	4(1)	5(6)	7(70)	0.4	Removed	Repetition	
68 #	Past is past and future is future, so I engage completely with the present moment and enjoy life	Let-go	No response (2)	1 (0)	2(0)	3(0)	4(3)	5(5)	8(80)	0.6	Removed	Repetition	

69	I am not able to completely part from negative thinking however hard I try	Let-go	No response (0)	1 (0)	2(2)	3(0)	4(3)	5(5)	8(80)	0.6	Retained	Rephrased	I am not able to completely detach from negative thinking however hard I try
70	In adverse or challenging situations, I am able to hold on to optimism or at least have a neutral outlook	Let-go	No response (0)	1 (0)	2(0)	3(3)	4(3)	5(4)	10(100)	1	Retained		
71 ++	I tolerate at a great personal cost to me	Tolerate										New item	
72 ++	I appreciate the variety in perspectives of people and value them	Accommodate										New item	
73 ++	I am flexible and accommodative to situations and people	Accommodate										New item	
74 ++	I get anxious and paralyzed whenever I have to make	Decide										New item	

	important decision												
75 ++	I can swiftly stop and divert from unwanted thoughts	Let-go										New item	

Column ‘Scores given by experts (No. of experts)’ refers to number of experts providing a specific rate to usefulness of items on a scale of 1–5 (1 – Not appropriate, 2 - Least appropriate, 3 – Somewhat appropriate, 4 – Appropriate, 5 – Most appropriate). No response refers to no score provided by the experts.

*Items with CVR score ≤ 0.6 retained in the final list, considering their appropriateness in measuring the respective power.

#Items with CVR score ≥ 0.6 removed from the final list, due to either repetition or inappropriateness of the item.

++New items added to the final list based on the suggestions from the experts and investigators

In addition, five new items (71 - 75) were added to the list as per the suggestions of the experts, which was found to be appropriate by the investigators.

Despite the cut off based on CVR score for retention or removal of an item, based on researcher’s experience and experts’ suggestions, retention or removal of items was done irrespective of the CVR score as shown below:

- As most of the experts reported the scale to be lengthy, fourteen items (2, 7, 8, 9, 12, 13, 17, 25, 48, 53, 54, 60, 66, 68) that appeared to be repetition were removed, despite the CVR score being ≥ 0.6 .
- Four items with CVR score ≤ 0.6 were retained as it is (59) or after rephrasing (4, 14, 58).

After making all the modifications as suggested by the experts, the final scale developed consisted of 45 items shown in Table 2.

Table 2. Final list of items in the scale to assess yoga-based well-being

S.No.	Items
1	I have the courage to face the life challenges

2	I get anxious by the challenges, but never get crippled by it
3	I try my best to face the challenges
4	I welcome challenges as I always learn something new
5	I co-operate with all (family, friends, colleagues) naturally
6	I co-operate for the sake of duty
7	I extend my co-operation with all, irrespective of their co-operation with me
8	I co-operate selectively based on the fulfilment of my expectations
9	I co-operate with my superiors and juniors more naturally than peers
10	I get irritated for simple reasons
11	I get disturbed by people and situations, but I tolerate and manage
12	I value others' viewpoints and tolerate accordingly
13	I am able to tolerate discomfort without losing inner balance
14	I tolerate at a great personal cost to me
15	I understand the larger perspective and transform negativity into positivity
16	I am able to provide necessary space and support for other's growth
17	I appreciate the goodness in everything and keep myself positive
18	I am able to accept the ideas, expression of others even if they seem contradictory to mine
19	I appreciate the variety in perspectives of people and value them
20	I am flexible and accommodative to situations and people
21	I am capable enough to delineate what is sustainable from what is not
22	I am good enough to distinguish what is best and worst for me

23	I lack clarity in identifying issues at the beginning itself
24	I feel the pulse of people and do justice by doing the needful
25	I often get confused and become indecisive
26	I understand the importance of certain key decisions, but don't have the power to decide
27	I often depend on others' opinion to decide most of the things in my life
28	Often I decide impulsively and regret later
29	I take timely decisions accurately
30	I decide appropriately considering the needs and intentions of self and others
31	I get anxious and paralyzed whenever I have to make important decision
32	As much as I give proactive suggestions, I disengage promptly once my turn is over
33	I often get carried away easily by sensory temptations
34	I allow my mind to think freely or to be in silence as and when required
35	Often I go off the task and later realise the waste of time
36	My senses are under my control and I use them as a master
37	I am impatient and become reactive when faced with distressful thoughts or situations
38	I often get influenced by others thoughts, behaviours and actions
39	I am able to let go of the past and hold nothing of it in the heart
40	I sort out my everyday issues then and there and remain light
41	I focus on living in the present moment
42	I get overloaded with future plans and become anxious
43	I am not able to completely detach from negative thinking however hard I try

44	In adverse or challenging situations, I am able to hold on to optimism or at least have a neutral outlook
45	I can swiftly stop and divert from unwanted thoughts

5 Discussion

Most of the experts of Raja yoga practitioners gave their consent of agreeing with most of the scale items based on inner powers, developed to assess yoga-based well-being. In the next step, construct validity of the scale items will be tested with data from meditators and non-meditators. Many of the previous studies have tried to develop various scales to assess well-being in similar way but most of them ended up assessing one or few aspects of the well-being. Whereas well-being is a multi-dimensional construct with hedonic and eudaimonic domains, and needs to be assessed in a holistic way.

An earlier study by Huppert and So proposed a conceptual framework to assess well-being in a comprehensive way. They provided ten features from both hedonic and eudaimonic aspects of well-being: competence, emotional stability, engagement, meaning, optimism, positive emotion, positive relationships, resilience, self-esteem, and vitality [3]. Another study pursued it further and developed a composite measure from the 10 items. This measure was applied in 21 European countries to get insights into well-being both at the level of individual dimensions as well as overall well-being. They found that this multidimensional measure could provide clear patterns of well-being across 21 countries as both an individual measure as well as a composite score. However, the study reported inconsistency in scaling as the major limitation in assessing multidimensional psychological well-being [11].

Present study is one of the first of its kind, which looks at well-being from a yogic perspective and covers both the feelings (hedonic) and the functioning (eudaimonic) aspect giving a comprehensive outlook. Each inner power requires adaptation at the feeling level in such a way that leads to accurate functioning resulting in inclusive satisfaction to both the self and others. The evolving science of well-being also recommends focusing on flourishing domain i.e. to account for what makes people flourish. This points toward ascertaining the inherent human assets and building the same to tap well-being both as an individual and as a society [7]. This scale based on yogic inner powers takes account of one's attitude and action, which play a vital role in one's well-being, and thus seems more generic for application to any section of society irrespective of gender, class, culture, country etc. In addition, it can also find application to both healthy as well as not healthy (physical health) people, as inner powers have more to do with psychological health than mere physical health. It can also act as an encouraging tool for improvising one's well-being through undertaking on building up one's inner power by practice

of yoga. Moreover, the inner power being an inherent quality of humanity anyone and everyone can develop and exercise the same. Thus, it promises a universal approach for assessment and enhancement of well-being.

6 Conclusion

A generic scale to assess yoga-based well-being was developed based on inner powers integral in classical Yogic texts and taught in Brahmakumaris Raja yoga meditation tradition. Ten experts from Raja yoga meditation tradition with substantial educational background validated the scale and agreed with most of the scale items. Based on their suggestions and incorporation of required modifications, the final scale contained 45 items. In future, construct validity of these scale items will be tested with data from meditators and non-meditators. This scale assesses all the basic components of one's well-being – coping mechanism, overall thriving and sustainability. Being holistic, it can prove to be a potential measure of assessing well-being as well as a scale of motivation to enhance well-being.

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Assessing the Impact of Rajyoga Meditation in Handling Burnout in Healthcare Workers

Mohit Dayal Gupta¹, Shekhar Kunal², Girish MP², Ekta Chalageri³, Deepak Kumar¹, Vivek Singh¹, Ankit Bansal¹, Vishal Batra¹, Jamal Yusuf¹, Saibal Mukhopadhyaya¹, Akshita Gupta⁴, Anubha Gupta⁴

¹Department of Cardiology, Govind Ballabh Pant Institute of Post Graduate Medical Education and Research, Delhi, India

²Department of Cardiology, ESIC Medical College and Hospital, Faridabad, Haryana

³Prajapita Brahmakumaris Ishwariya Vishwa Vidyalaya

⁴SBILab, Department of ECE, IIIT- Delhi, India

* Corresponding Authors (emails: drmohitgupta@yahoo.com, anubha@iiitd.ac.in)

Introduction and Objective:

COVID-19 pandemic led to significant burden on the healthcare workers (HCWs) in terms of patient care and psychological issues [1]. HCWs were reported to have unusual high burnout rates during the COVID-19 pandemic [2]. Since Rajyoga meditation (RYM) has been shown to have clinical benefit in a multitude of conditions such as coronary artery disease, tension headache, depression and anxiety [3], this study evaluates the impact of RYM versus stress management counseling (SMC) among HCWs in India via the analysis of the 12-lead ECG data using artificial intelligence-based ML algorithms.

Methods:

This was a prospective observational study wherein N=203 healthcare providers ≥ 18 years of age including residents, physicians, nurses and paramedical staff involved in COVID care were recruited in two groups: Rajyoga meditation (RYM) (n=100) or stress management counseling (SMC) (n=103). Subjects in RYM received rajyoga for 3 months including one week offline and thereafter, virtual mode. SMC group received counselling for 1 day in offline mode and thereafter, received positive thoughts on a weekly basis. All subjects were assessed for burnout syndrome (Mini Z questionnaire) at baseline, after 4 weeks, and after 12 weeks and were labelled as burnout or satisfied based on the response to question 3 of the Mini-Z questionnaire. Raw ECG data was collected with 12 leads for 10 seconds duration. For baseline comparison between groups, t-test for two independent sample mean was used for continuous variables and Chi-square test was used for categorical variables.

Raw ECG data was processed using bandpass filters to remove noise. Time Series features were extracted for each patient and were scaled to z-scores with mean to zero and variance to one. A total of 30 top features were selected and used to build a binary random forest classifier for the classification of burnout (class-1) versus non-burnout or satisfied (class-0) classes. For each patient, the likelihood of belonging to the ‘not burnout’ class was computed for every visit as the probability of belonging to the ‘not burnout’ class as predicted by the trained RF classifier. The Wilcoxon Unsigned Rank test were conducted to evaluate the statistical significance of the changes in probability as visits progressed within each RMY and SMC groups.

Results

Baseline demographic details have been compared in Table 1. Practice of RYM for 12 weeks resulted in significant decrease in burnout in question no. 3 of Mini-Z questionnaire (Baseline mean score: 1.87, at 12 weeks mean score- 1.34; $P < .001$). There has been reduction in burnout from visit-1 to visit-3: burnout visit-1 (27.2%), visit-2 (23.8%), and visit-3 (19.3%) as observed via the class distribution of the data.

Table 1: Baseline comparison data between groups

Variables	RYM (n=100)	SMC (n=102)	t/X2	p-value
Age in years	38.0 (11.0)	31.8 (10.8)	4.07	<.001
*Sex Ratio Male :Female	28:72	34:68	0.675	0.411
*Married: Single	57:43	49:53	1.63	0.202
*Nuclear : Joint	70:30	64:38	1.19	0.275
*Highest education Graduate : Post Graduate	57:43	46:56	4.16	0.245
Burnout	1.87 (0.925)	1.94 (1.042)	6.39	0.002

Visit-3 data was used to build the classifier with a 70-30 train-validation split. Results were tested on the Visit-1 and Visit-2 dataset, treating them as the unseen data. Prior to training the classifier, an upsampling of the minority class (burnout) was performed in the training set using the Synthetic Minority Oversampling Technique (SMOTE) method because there was a class imbalance of approximately 1:5. On the validation data, the classifier reported an accuracy of 90%, F1-score of 80%, Precision of 100%, and a recall of 67%. On the unseen Visit-1 and Visit-2 data, the accuracy was reported to be 69%. The statistics (mean, median,

and standard deviation) of the probabilities of belonging to the ‘not burnout’ class in the three visits of both the RYM and SMC groups as predicted by the trained RF classifiers has been highlighted in Table-3. Results indicate that the probability of being ‘not burnout’ significantly improved in the mean and median from visit-1 to visit-3 for the RYM group, but the same declined for the SMC group. A higher probability indicated that the cardiac health status improved for the RYM group despite work pressure, while the improvement was not observed in the SMC group.

Table-2: Statistics computed on the probabilities of being ‘not burnout’ as predicted by the random forest classifier

Probabilities of being ‘not burnout’ as predicted by the classifier	RYM Group (Treatment)			SMC Group (Control)		
	Visit 1	Visit 2	Visit 3	Visit 1	Visit 2	Visit 3
Mean	0.61	0.63	0.7	0.63	0.6	0.5
Median	0.61	0.64	0.74	0.65	0.62	0.54
Standard Deviation	0.14	0.14	0.2	0.13	0.14	0.23
	RYM Group (Treatment)			SMC Group (Control)		
	Visit 1 - Visit 2	Visit 2 - Visit 3	Visit 1 - Visit 3	Visit 1 - Visit 2	Visit 2 - Visit 3	Visit 1 - Visit 3
p-value of Wilcoxon unsigned rank test	0.29	0.003*	1.3 e-05*	0.13	0.0002*	1.5 e-06*

*: statistically significant result at a p-value < 0.05

Discussion and Conclusion

In the present study, we compared the impact of RYM and stress management counseling in reducing depression, anxiety, stress and burnout among healthcare workers. The interesting finding of the present study was that RYM had significant impact as compared to SMC in reduction of burnout among healthcare workers. Using ML models, we were able to show that the cardiac status of the RYM group improved statistically significantly, while such an improvement was not observed in the SMC group. These findings are of definite importance as it is a step forward in highlighting the role of RYM as one of the solutions in addressing the adverse effects of COVID-19 on the mental and cardiac health status of HCWs. Findings of the present study are concurrent with the previous studies of mind body interventions including meditation, yoga and pranayama.

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Interhemispheric neural coupling patterns during Rajyoga meditation and music listening

Pradeep Kumar G1, Kanishka Sharma2, Adarsh A1, Amrutha Manvi1, and AG Ramakrishnan1

1 Department of Electrical Engineering, Indian Institute of Science, Bangalore pradeepkg@iisc.ac.in

2 School of Education, Rishihood University, Sonipat 131021, India

Abstract:

Meditation is a mental exercise practiced primarily to improve the core psychological, emotional and attention regulation. We investigate the changes in the coherence between symmetric EEG electrode pairs across hemispheres during the meditation practiced by long term Brahmakumaris Rajyoga meditators with open eyes and during listening to music by controls as the comparable task. FC measure derived from coherency, the imaginary part of coherency (ICoh), is used to study the changes in interhemispheric coherence between symmetric electrodes. Coherence quantifies the correlation between two brain regions in the spectral domain. During baseline conditions, higher |ICoh| is found globally in higher beta and gamma bands than controls. Further, in meditators, |ICoh| significantly decreases across all regions and bands except in the alpha band during meditation. However, the control subjects without knowledge of meditation showed no change in |ICoh| during the music session. Distinct patterns of changes are observed in different frequency bands during meditation in the meditators and music-listening session in the control subjects, indicating varied information processing between the right and left hemispheres. We found decreased |ICoh| between the frontal electrodes, implying increased self-awareness in meditators.

Keywords: EEG, Meditation, Rajyoga, Interhemispheric coherence, Imaginary part of coherency

1 Materials and methods

1.1 Subjects and EEG recordings

The dataset consists of 27 (11 female) healthy right-handed meditators (mean age: 39.8 years SD: 8.4 years) with an estimated lifetime meditation experience of 14.2 ± 9.2 years. They were recruited from different meditation centres in Bangalore through the centre trainers. We also recruited 30 (12 female) healthy right-handed controls (mean age: 37.3 years SD: 10.5 years) from the student and staff community of the Indian Institute of Science. Participants who had no previous experience of any type of meditation were recruited through awareness talks on meditation studies. Both meditators and controls were screened for any history of general health issues, and neurological/psychiatric illness. All the subjects had normal or corrected to normal vision and participated in the study voluntarily. Informed consent was obtained from the participants and they were briefed about the study before performing the

experiment. The ages of meditators and controls matched with $p = 0.243$ tested with the Wilcoxon rank-sum test. Ethical clearance for the experimental protocol was obtained from the IISc Institutional Human Ethics Committee, with IHEC number 02/20201126. The raw EEG data was recorded using a 64-channel waveguard cap and ANT Neuro mylab acquisition system. Electrodes were placed according to the international 10-10 system. The data were recorded with a sampling rate of 1000 Hz. Although the impedance threshold in the acquisition system was set to 20 k Ω , the electrode impedance was maintained at less than 10 k Ω during recording. EEG signals were referenced to CPz during acquisition. Other physiological signals, namely ECG, respiration and GSR were also recorded with the same acquisition system.

1.2 Experimental setup

The participants sat in a dark room with the comfortable seating of their choice. None of them sat in a cross-legged position. Meditators and controls performed the instructed task. Subjects were given enough time to adapt to the conditions of the recording room while the experimenters briefed them about the experiment. The average preparation time for the recording was approximately 30 minutes. Subjects were instructed to minimize movement during the recording and baseline recording was performed for 5 minutes each with eyes open (EO1) and closed (EC1) conditions before the meditation or music session. Meditators practiced BKRY meditation (MED) for approximately 10 minutes, and control subjects listened to music (MUS) as a comparable task. The music was selected from the original soundtrack of the playlist on youtube channel of the Brahmakumaris organization and is also being used by a few meditators of this school of meditation as background music to aid the practice in the initial years. Music listening was considered as the task comparable to meditation in the present study since many intervention studies have reported the effect of music listening as a good task to compare with meditation[1],[3],[2]. Final baselines were again recorded with eyes closed (EC2) and open (EO2) conditions for a duration of 5 minutes each. The eyes open and closed segments were not randomized since the meditation and music segments were recorded with the eyes open condition.

2. Imaginary part of coherency, ICoh

Proposed by [4], ICoh is computed using only the imaginary part of the coherency given in equation (3) to study the interactions between different brain regions. ICoh is considered to exclude coherent sources with phase lag of zero thereby Interhemispheric EEG coherence 3 reducing the effect of field spread due to volume conduction. ICoh is defined as

$$ICoh_{ij}(f) = Im(C_{ij}(f)) = Im\left(\frac{S_{ij}(f)}{\sqrt{S_{ii}(f)S_{jj}(f)}}\right) \quad (1)$$

From equation (5)

$$ICoh_{ij}(f) = \frac{\langle |X_i(f)| |X_j(f)| \sin(\phi_i(f) - \phi_j(f)) \rangle}{\sqrt{\langle |X_i(f)|^2 \rangle \langle |X_j(f)|^2 \rangle}} \quad (2)$$

where Im stands for the imaginary part. The value of ICoh ranges from -1 to 1. A positive value implies that the electrodes i and j are interacting and j is earlier than i, indicating the flow of information is from electrode j to i and if negative, vice versa. Further, since the value of ICoh is proportional to the sine of the angle between the two channels at that frequency, it can be distinctly different from MSC, which is a magnitude measure. We use the absolute value of ICoh ($|ICoh|$) as a different measure of connectivity. After three point smoothing, ($|ICoh|$) values of all the electrode pairs are pooled together to obtain the grand average [5] and also lobewise pooled to present more generalized data presentation by performing data reduction.

3. Results

To identify the frequency and lobe-specific networks in experienced meditators during the baseline and meditation conditions, frequency plots of $|ICoh|$ are obtained. The left column of Fig. 1a presents the grand average $|ICoh|$ values of all the interhemispheric electrode pairs in EO1M baseline, MED, and EO2M conditions. Solid lines represent the grand average and the respective light-colored bands indicate the SEM. The results show that $|ICoh|$ decreases significantly (at Bonferroni significance level of $0.05/45 = 0.001$) during MED from the EO1M values in the high-frequency band from 21 to 45 Hz. The frequency plots of $|ICoh|$ given in Fig. 1a right column, reveal no significant change in the grand average of $|ICoh|$ values during MUS from EO1C and EO2C conditions in any band. The grand average of $|ICoh|$ comparing the baseline conditions of meditators and controls given in the left column of Fig. 1b suggests that there does not exist a difference in the EO1 condition across groups prominently except in high beta and low gamma bands. However, these differences are not statistically significant. The differences between the groups during task conditions i.e., MED and MUS session increases further as shown by the right column of Fig. 1b. It is observed that $|ICoh|$ decreases in delta, theta, beta, and slow gamma bands but increases in alpha bands. However, the significance at Bonferroni significance level of $p \leq 0.05/45 = 0.001$ is found only at 26 Hz and 35-45 Hz.

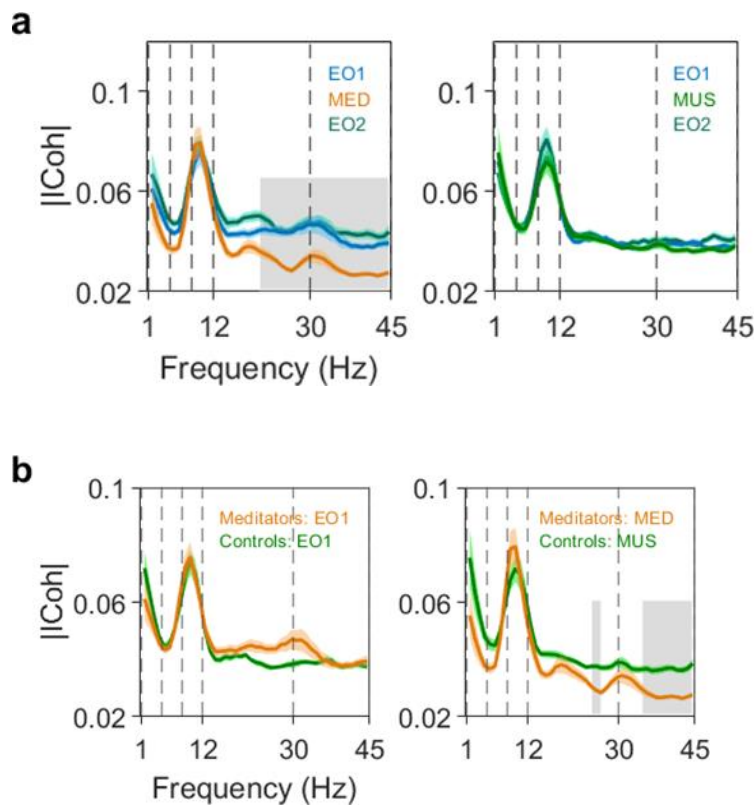


Fig. 1. $|ICoh|$ in meditators and controls: a) Grand average of $|ICoh|$ across all the electrode pairs as a function of frequency during different conditions within the group. The respective light color band associated with each solid line represents SEM. Left column: meditators and right column: controls. The vertical dashed lines are the boundaries between the EEG freq. bands. (b) Same as in (a) but across groups during EO1 (left) and MED/MUS (right) sessions. The grey shaded area indicates the region of statistical differences between the conditions (EO1&MED, EO1&MUS) and groups after Bonferroni correction for multiple comparisons.

4. Conclusion

Our experimental results show a clear change in the interhemispheric coherence pattern with coherency-based FC measure during meditation indicating a possible change in the state of consciousness of the practitioners. In summary, $|ICoh|$ is lower in meditators than the mean age-matched control subjects, implying that the effect of meditation is to preserve the EEG spectral synchrony. The results of this study suggest a new approach to utilizing interhemispheric coherence in meditation studies.

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Mechanics and Metaphor: The Subtle Body (sūkṣma śarīra) in the Sāṃkhya Kārikā, the Yogabindu, and the Yogavāsiṣṭha

Christopher Key Chapple¹

¹Doshi Professor of Indic and Comparative Theology

¹Director, Master of Arts in Yoga Studies

¹Loyola Marymount University

Abstract:

The subtle body plays an important role in the pan-Indic theory of the need to escape the repeating cycle of painful habitual sullied thought and actions. Afflictions and obstacles have been identified variously across traditions: the Buddhist and Yogic *kleśas*, the Jaina *kaṣāyas*, the Vedantic *upādhis*. They dwell and fester in subconscious memories known as *saṃskāras* or *vāsanās*. They govern present and future behavior. They cluster together within the subtle body. They can only be extirpated through sustained *tapas* and meditation. This presentation will explore the metaphors in the *Sāṃkhya Kārikā* (ca. 400 C.E.) that describe their functionality. Passages from the *Yogabindu* (6th century) itemize paths to uncovering and neutralizing their allure through dreams, past life recollection, and a fivefold Yoga practice. The *Yogavāsiṣṭha* (11th century) suggests that one can restructure and counteract their influence by expanding the definition of self to include sustained reflection on the interconnection and continuity of conscious awareness.

Effect of short term add-on Yoga intervention in adolescent depression: A pilot study

Suma Bhaskar¹, Rahul Venugopal¹, Lopamudra Naik¹, Arun Sasidharan¹, Ramajayam G¹, Bindu M Kuty¹, Rajendra KM², Hemant Bhargav³, Ravindra PN.¹

¹Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS, ²Child & Adolescent Psychiatry, NIMHANS, ³Dept. of Integrative Medicine, NIMHANS, Bengaluru, Karnataka, INDIA.

suma.bhaskar@gmail.com

Abstract:

Adolescent depression is the leading cause of disability and a public health concern globally. Despite effective pharmacological and psychotherapeutic approaches, the symptoms are recurrent and persistent and are associated with significant side effects and suicidality. In recent years, there has been growing interest in the potential therapeutic advantages of yoga, especially in addressing mental health issues like adolescent depression. Our preliminary data showed a significant reduction in depression scores, mind wandering and sleep problems, trend decrease in negative affect and a significant increase in overall wellbeing and healthy emotionality. Resting HRV data showed a significant reduction in vagal activity and a moderate increase in sympathetic activity as well as enhanced P300 in frontal electrodes.

Keywords: Adolescent depression, Yoga, Resting HRV, P300

1 Introduction:

Adolescent depression is the leading cause of disability and an important public health concern because of its increasing prevalence, early onset and negative impact on the individual, family and community. Despite effective pharmacological and psychotherapeutic approaches, the symptoms are recurrent and persistent (1) and are associated with significant side effects and suicidality. Yoga has gained considerable attention in recent years for its potential therapeutic benefits, particularly with several studies demonstrating the effectiveness of yoga in alleviating depression scores in adults (2-4). However, as far as adolescent depression is concerned, there are very few studies; all of them have reported a significant reduction in depression and anxiety with two weeks of intervention (5, 6). Whereas the physiological mechanisms associated with add-on yoga regimens have not been explored. We are undertaking a large study with 6 weeks of add-on Yoga intervention, the preliminary pilot observations with regard to psychometric scales, resting HRV and p300 are reported here.

2 Materials and Methods:

Newly diagnosed or recurrent depressed adolescents (ICD-10 criteria F 32) aged between 12 and 18 years of both genders were recruited for the study. After obtaining written informed consent and assent from the parents and subjects, respectively, the subjects were allotted to the treatment as usual (TAU) group or the treatment as usual plus yoga intervention (YTAU) group as per their choice. A trained yoga therapist administered the Yoga module (supervised contact sessions of 1 hour per day for 2 weeks plus online supervised tele-session for 4 weeks). The pharmacotherapy was decided by the consultant psychiatrist. Psychometric scales, resting EEG and ECG (lead II) at a sampling rate of 1 kHz, and attention capabilities (auditory oddball - P300) were assessed at baseline and after 6 weeks of Yoga intervention. Neurokit2 based functions and custom scripts (based on standard algorithms) written in Python used for the analysis, and R/Jamovi was used for statistical comparison.

3 Results:

3.1 Psychometric measures (Table 1):

All the scales were measured at baseline and after 6 weeks of intervention in both the groups. The assessment of the severity of depression was done using the Hamilton Depression Rating Scale (HDRS). Preliminary observations showed a significant decrease ($p=0.002$, $ES=1.88$) in depression severity in the YTAU group, whereas the TAU group showed a moderate decrease ($ES=0.56$) though not statistically significant. Assessment of positive and negative affect (PANAS) showed no change in positive and a trend decrease in negative affect in the YTAU group, whereas the TAU group showed a significant increase in positive and no change in negative affect. Mind wandering was significantly reduced in YTAU, but there was no change in the TAU group. Both Global emotionality score (ESQ) and wellbeing (EPOCH) showed a significant increase in YTAU with moderate and high effect size respectively, whereas the TAU group demonstrated a significant increase in wellbeing, but their emotionality score did not show any change. Sleep habits (CASC score) showed a significant decrease in sleep disturbance, indicating better sleep quality in YTAU whereas no change was observed in the TAU group.

Sl no.	Variable TAU group	Pre-value (mean±SD)	Post-value (mean±SD)	t-value	p-value	Effect size (Hedge's g)	CI _{95%}
1	HDRS	22.3 ± 9.0	15.5 ± 8.4	1.62	0.17	0.56	-0.22, 1.29
2	PANAS_Positive	19.2 ± 8.6	23.7 ± 5.4	-1.12	0.03	-0.38	-1.08, 0.34
3	PANAS_Negative	34.3 ± 9.6	27.2 ± 9.9	2.09	0.09	0.72	-0.11, 1.49
4	MWQ	24.7 ± 5.5	22.0 ± 3.7	0.90	0.41	0.31	-0.40, 0.99
5	ESQ_Global	3.3 ± 0.7	3.2 ± 1.0	0.38	0.72	0.13	-0.55, 0.80
6	EPOCH_Global	12.6 ± 5.7	9.8 ± 3.4	1.48	0.02	0.51	-0.25, 1.23
7	CASC	27.2 ± 8.7	27.5 ± 11.5	-0.11	0.92	-0.04	-0.71, 0.64

Sl no.	Variable YTAU group	Pre-value (mean±SD)	Post-value (mean±SD)	t-value	p-value	Effect size (Hedge's g)	CI _{95%}
1	HDRS	26.2 ± 6.3	6.5 ± 7.3	5.47	0.002	1.88	0.60, 3.48
2	PANAS_Positive	30.2 ± 13.7	38.2 ± 6.2	-1.53	0.19	-0.53	-1.37, 0.26
3	PANAS_Negative	34.2 ± 10.1	22.7 ± 7.8	2.32	0.07	0.80	-0.06, 1.75
4	MWQ	20.5 ± 3.4	12.3 ± 3.3	5.31	0.003	1.82	0.57, 3.39
5	ESQ_Global	3.4 ± 0.8	4.4 ± 0.6	-2.40	0.06	-0.82	-1.79, 0.04
6	EPOCH_Global	12.3 ± 3.3	15.4 ± 2.9	-4.75	0.005	-1.63	-3.07, -0.46
7	CASC	26.8 ± 4.3	18.5 ± 7.6	2.95	0.03	1.01	0.09, 2.08

Table 1. Results of Questionnaire data at baseline and after 6 weeks of intervention in TAU & YTAU groups. Abbreviations: HDRS – Hamilton depression rating scale, PANAS – Positive and negative affect schedule, MWQ – Mind wandering questionnaire, ESQ Global – Emotional style questionnaire, EPOCH Global - Engagement, Perseverance, Optimism, Connectedness, and Happiness questionnaire, CASC - Child and Adolescent Sleep Checklist.

3.2 Resting heart rate variability (Table 2):

Frequency domain (LFn, HFn, LF/HF ratio) parameters did not show any change in the TAU group, whereas a significant reduction in HFn but no change in LFn and LF/HF ratio was observed in the YTAU group. Non-linear parameters SD1 and SD2 which are indices of short-term and long-term RR interval fluctuations, respectively, showed a significant enhancement in the TAU group with a moderate effect size whereas YTAU showed no change. Cardiac Vagal Index (CVI) and Cardiac Sympathetic Index (CSI) are the indices for cardiac parasympathetic function (vagal activity unaffected by sympathetic activity) and cardiac sympathetic function independent of vagal activity respectively. TAU group showed a trend towards an increase in CVI and no change in CSI, whereas, YTAU demonstrated no changes in these indices. Lempel-Ziv Complexity (LZC) which quantifies the regularity of the cardiac signal, did not show significant difference in either of the groups

SI no.	Variables TAU group	Pre-value (mean±SD)	Post-value (mean±SD)	t-value	p-value	Effect size (Hedge's g)	CI _{95%}
1	LFn	0.38 ± 0.13	0.43 ± 0.17	-0.64	0.55	0.22	-0.89, 0.48
2	HFn	0.26 ± 0.12	0.27 ± 0.13	-0.20	0.85	-0.07	-0.74, 0.61
3	LF/HF ratio	1.8 ± 1.1	2.1 ± 1.6	-0.48	0.65	-0.17	-0.92, 0.57
4	CSI	3.2 ± 0.9	2.6 ± 0.5	1.61	0.17	0.55	-0.24, 1.40
5	CVI	4.2 ± 0.6	4.5 ± 0.5	-2.46	0.06	-0.85	-1.82, 0.03
6	SD1	22.37 ± 15.07	31.22 ± 21.04	-2.50	0.05	-0.86	-1.68, 0.02
7	SD2	61.10 ± 29.19	77.52 ± 37.34	-2.28	0.07	-0.78	-1.58, 0.06
8	LZC	0.7 ± 0.1	0.8 ± 0.1	-1.91	0.12	-0.65	-1.55, 0.16

SI no.	Variables YTAU group	Pre-value (mean±SD)	Post-value (mean±SD)	t-value	p-value	Effect size (Hedge's g)	CI _{95%}
1	LFn	0.36 ± 0.12	0.44 ± 0.15	-1.70	0.15	-0.58	-1.32, 0.20
2	HFn	0.47 ± 0.13	0.32 ± 0.16	3.63	0.01	1.25	0.22, 2.23
3	LF/HF ratio	0.9 ± 0.5	2.3 ± 2.3	-1.82	0.13	-0.62	-1.50, 0.19
4	CSI	1.9 ± 0.8	2.4 ± 1.2	-1.06	0.34	-0.36	-1.15, 0.40
5	CVI	5.2 ± 0.9	4.8 ± 0.4	1.14	0.31	0.39	-0.37, 1.19
6	SD1	147.02 ± 204.59	49.58 ± 37.56	1.11	0.32	0.38	-0.35, 1.06
7	SD2	186.08 ± 213.84	96.75 ± 37.89	1.08	0.33	0.37	-0.35, 1.06
8	LZC	0.9 ± 0.1	0.8 ± 0.1	-1.82	0.13	-0.62	-1.50, 0.19

Table 2. Results of HRV parameters at baseline and after 6 weeks of intervention in both TAU & YTAU groups. Abbreviations: LFn – Normalized low frequency, HFn - Normalized high frequency, LF/HF ratio - Ratio of LF to HF power, CSI - Cardiac Sympathetic Index, CVI - Cardial Vagal Index, SD1 - standard deviation of points perpendicular to the identity line, SD2 - standard deviation of points parallel to the line of identity, LZC - Lempel-Ziv Complexity.

3.2 Auditory Oddball

P300 showed a trend towards a higher area under the curve in Fz p=0.06, ES =0.94) with 6 weeks of add-on yoga intervention, whereas TAU group did not show any significant changes.

TAU group	Mean AUC	SD
Pre Fz	204	246
Post Fz	115	201
Pre Cz	-160	213
Post Cz	-162	189
Pre Pz	-314	200
Post Pz	-326	191

YTAU group	Mean AUC	SD
Pre Fz	-158	210
Post Fz	157	394
Pre Cz	-296	270
Post Cz	-165	348
Pre Pz	-226	270
Post Pz	-287	288

TAU group		t	df	p	Effect size (Cohen's d)
Pre Fz	Post Fz	0.5856	5	0.584	0.23908
Pre Cz	Post Cz	0.0163	5	0.988	0.00664
Pre Pz	Post Pz	0.0943	5	0.928	0.03852

YTAU group		t	df	p	Effect size (Cohen's d)
Pre Fz	Post Fz	-2.322	5	0.068	-0.948
Pre Cz	Post Cz	-1.181	5	0.291	-0.482
Pre Pz	Post Pz	0.635	5	0.553	0.259

Table 2. Results of P300 area under curve mean & standard deviation with effect size at baseline and after 6 weeks of intervention in TAU & YTAU groups

6 Discussion

This is the first study to report the effect of short-term add-on Yoga intervention on neurophysiological mechanisms in adolescent depression. Our preliminary data revealed that incorporating yoga as an add-on intervention for adolescent depression over a period of six weeks yielded favorable outcomes, notably a significant reduction in depression, negative affect, mind wandering, sleep disturbance, and a significant increase in healthy emotionality and wellbeing. At the same time, there was a significant reduction in vagal activity and a moderate increase in sympathetic activity, which is counterintuitive. Further, attention allocation resources at frontal areas are increased, as reflected in enhanced p300 in

frontal electrodes. Results with a greater number of subjects could unravel the mechanism involved in bringing about the positive psychological benefits of Yoga intervention.

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Development and validation of vipassana proficiency scale

Ramajayam Govindaraj¹, Ratna Jyothi Kakumanu², Rahul Venugopal¹, Mariamma Philip³, Seema Mehrotra⁴, Nikhil Mehta⁵, Ravindra Panth⁶ and Bindu M Kutty¹

¹Centre for Consciousness Studies (CCS), Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India.

²Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India

³ Department of Biostatistics, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India.

⁴Department of Clinical Psychology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India.

⁵ Vipassana Research Institute (VRI), Global Pagoda, Mumbai, Maharashtra, India.

⁶Department of Buddhist Philosophy, Nava Nalanda Mahavihara, Nalanda, Bihar, India.

#These authors contributed equally and may be considered as joint first authors

*Corresponding Author(s)

ramji.zero@gmail.com

Abstract:

The objective of the study was to develop and validate a comprehensive Vipassana proficiency (VP) scale based on Buddhist philosophy. Initially 50 items relevant for Vipassana proficiency was pooled and finalized by the authors based on their experience in Buddhist meditation and philosophy. These initial scale items were independently validated for the appropriateness of content by 20 experts in Buddhist meditation and philosophy. The content validated scale was tested for construct validity among Buddhist meditators (n=311). Mindfulness Attention Awareness Scale (MAAS) and Perceived Stress Scale (PSS) were used for testing convergent and divergent validity respectively. The content validity ratio (CVR) for the items calculated from the expert's scores ranged from 0.7 to 1.0. Exploratory factor analysis (EFA) with maximum likelihood method revealed a three-factor solution (Factor 1- Mindfulness and application of virtues; Factor 2- Health and Harmony with self & others; Factor 3- Control over obstacles). The final three factor scale with 49 items suggested a statistically significant model fit (chi square=2522; df=1124; p <0.001) with Comparative Fit Index (CFI) of 0.83 and 50% cumulative variance on confirmatory factor analysis (CFA). The newly developed VP scale correlated positively (r=0.6, p < 0.001) with MAAS, and negatively (r= -0.5, p < 0.001) with PSS, suggestive of adequate convergent and divergent validity. Test-retest reliability and internal consistency

of the scale was assessed by Cronbach's alpha and it ranged between 0.8-0.9. The newly developed VP scale has good psychometric property from the Indian context. Further cross-cultural validation in larger sample is required.

Keywords: Vipassana, Proficiency, Validation, Mindfulness, Buddhism.

1 Introduction

Vipassana is a mindfulness meditation technique rooted in Buddhism [1]. One of the main principles of Vipassana is that reactions to bodily sensations, emotions & thoughts result in human behavior. When the experience is pleasant, it leads to attachment & craving and if the experience is unpleasant, it leads to aversion. When one attempts to satisfy craving or avoid aversion, it forms a vicious cycle and leads to maladaptive behavior, stress and sorrow [2].

Buddhism specifies Vipassana as a solution to break the vicious cycle of craving and aversion. The central logic of Vipassana is developing mindfulness through various strategies. Breath focused-meditation and body scanning are the two very commonly applied strategies to develop mindfulness. Breath focused meditation involves passive observation of inhalation and exhalation without any manipulation. Body scanning involves repeated scanning of the body from head to feet as a detached observer without reacting to the sensations or experiences that arises [1]. The Vipassana meditation in the tradition of Sayaki U Ba Kin as taught by Shri S.N. Goenkaji includes anapana (breath watching), Vipassana (Scanning of sensations and thoughts arising from the body and mind) and the practice ends with loving-kindness meditation (*mettā*) which involves loving thoughts with good wishes and pure feelings for the self and others.

Practice of mindfulness in Vipassana creates a fundamental shift in perspective, where the subjects start observing their internal sensations, thoughts and feelings as a detached observer without any attachment or aversion to experiences. Psychology literature defines this phenomenon as decentering or defusion [3,4]. This process of defusion enables one to gain mastery over their thoughts, emotions and behavior through repeated non-reactive exposure to uncomfortable internal sensations and experiences. Other psychological mechanisms that substantiate a positive behavior change with mindfulness includes habituation and counterconditioning.

As mindfulness promotes healthy cognitive reappraisals with a detached stance, it enables one to overcome excessive worries about the future or unnecessary ruminations of the past and hence reduces stress, depression, anxiety and promotes wellbeing through cognitive change [5].

In recent years, mindfulness-based meditation techniques including Vipassana are commonly practiced to enhance wellbeing. A recent meta-analysis reported the effect of mindfulness practices on asset based outcomes like health, job performance, compassion & empathy, mindfulness and positive psychology ranging from small to moderate effect size and a significant moderate effect on deficit based outcomes like stress, depression, anxiety, burnout and distress [6].

Despite mindfulness-based techniques' (including Vipassana) wide usage in well-being interventional studies, proficiency related to the practice is never measured systematically. Very commonly, number of years of meditation practice is taken as a proxy for proficiency. But recent literature reports that even some of the short-term meditation practitioners could also be as proficient as long-term meditators [7]. In this context, a validated scale for assessing the Vipassana meditation proficiency is an essential need for the Vipassana and related meditation research community

In this study, we aimed at development and validation of a Buddhist philosophy-based VP scale for research utility.

2 METHODS:

2.1 Sample & Procedure:

Subjects were recruited through Vipassana Research Institute, Global Pagoda, Mumbai. Vipassana meditation practitioners with a minimum experience of 1 year were recruited. Subjects were contacted through emails for recruitment and responses for the scale items were also obtained through the same medium. The characteristics of subjects are given in Table-1.

Table 1. Subjects' characteristics

S.No	Variables	Mean (SD) / Proportion (Percent)
1	Age	48 (14)
2	Males	185/311 (59.4%)
3	Females	126/311 (40.5%)
4	Years of Education	18 (2.5)

Phase I-Item generation:

Classical text of Buddhist philosophy (such as Abhidhamma) was reviewed to develop the items for the scale. Based on the texts and experience in meditation, the research team have finally arrived at 50 items

relevant for Vipassana proficiency scale. All the items were made in English with the key terms in Pali language transliterated in English as per the international transliteration standards. All the items included were approved by all the investigators by consensus.

Phase II-Content validation:

The items of the scale generated in phase I was sent to 20 experts in Buddhist philosophy and in Vipassana meditation practice for content validation. Experts were asked to rate (on a Likert scale from 1-5, 1 for 'Not useful' and 5 for 'Extremely useful') the suitability of items for assessing proficiency as per the Vipassana meditation-based theory. Items scored by at least 70% of the experts with 3 or more scores were retained.

Phase III-Construct validation:

Items which were confirmed as suitable for assessing Vipassana proficiency based on their expertise in Buddhist philosophy and Vipassana meditation theory by experts in the phase II, were sent to Vipassana meditation practitioners along with sets of other scales to assess construct validity. Exploratory Factor analysis was performed for identifying the latent factor structure, which was confirmed by Confirmatory Factor analysis. Mindfulness Attention Awareness Scale (MAAS) [8] & Perceived Stress Scale (PSS) [9] were used for assessing convergent validity and divergent validity respectively. MAAS is a 15-item scale for assessing dispositional mindfulness. The scale has been validated for psychometric properties in healthy and disease population. PSS is a psychological instrument widely used to assess perception of stress. It measures the magnitude to which a situation in one's life is perceived as stressful on a 5 point Likert scale.

2.2 Ethical Considerations:

The study was approved by the Institute Ethics Committee. (No. NIMI {/DO/ETI {ICS SUIS-COMM ITTEE /2013 Dated 5th June 2014). All the subjects had given their informed consents before participating in the study.

2.3 Statistical Analysis:

Analysis were conducted with Jamovi version 2.0 [10]. Descriptive statistics were used to examine the demographic characteristics of the subjects' responses. Incomplete responses (n=15) were removed. Both the Kaiser Meyer-Olkin (KMO) Measure of Sampling Adequacy (overall and for each variable) [11], and Bartlett's Test of sphericity [12] were conducted to test the adequacy of the correlation matrix for exploratory factor analysis. Confirmatory Factor Analysis (CFA) was conducted following Exploratory Factor Analysis (EFA) [13,14] to finalize the factor structure. Scree plot with eigen values were used to determine the dimensionality of the scale items. Convergent validity was assessed by

Pearson's correlation between VP scale and Mindfulness and Divergent validity was assessed by correlation between VP scale and Stress (PSS). Cronbach's alpha [15] was calculated to examine internal consistency with the overall final instrument and for each factor. Test-retest reliability was also conducted with a time gap of one week.

3. Results

3.1 Response rate:

The scale was sent to members (n=600) of Vipassana Research Institute for collection of construct validity related data. Responses were obtained from 326 (54.3%) subjects. Out of the 326 subjects, 15 subjects' responses were incomplete and hence not included in the analysis. For final data analysis, 311 subjects' responses were included. The descriptive statistics of 311 subjects for the items of VP scale is shown in Table 2.

Table 2 . Descriptive statistics for items of VP scale (n=311)

<i>Item</i>	<i>Mean</i>	<i>95% Confidence Interval</i>		<i>SD</i>
		<i>Lower</i>	<i>Upper</i>	
1	4.44	4.33	4.56	1.014
2	3.71	3.60	3.83	1.017
3	4.09	3.97	4.20	1.038
4	3.77	3.64	3.89	1.119
5	3.65	3.54	3.76	0.985
6	3.39	3.27	3.51	1.062
7	3.23	3.12	3.34	0.991
8	3.40	3.29	3.51	0.999
9	4.36	4.26	4.47	0.952
10	3.42	3.30	3.53	1.057
11	3.72	3.58	3.86	1.295
12	3.70	3.58	3.83	1.139
13	3.76	3.66	3.87	0.968
14	3.98	3.86	4.10	1.088
15	4.06	3.94	4.18	1.079
16	3.92	3.79	4.04	1.112
17	3.68	3.55	3.82	1.201

18	3.86	3.74	3.99	1.093
19	3.83	3.71	3.95	1.072
20	4.01	3.88	4.14	1.187
21	3.83	3.70	3.96	1.155
22	3.21	3.09	3.32	1.038
23	4.35	4.22	4.48	1.182
24	3.31	3.20	3.42	0.975
25	3.22	3.11	3.34	1.023
26	3.63	3.53	3.74	0.949
27	3.98	3.86	4.09	1.014
28	4.17	4.05	4.29	1.073
29	4.03	3.89	4.16	1.199
30	3.85	3.73	3.97	1.084
31	4.13	4.00	4.26	1.174
32	4.01	3.89	4.13	1.070
33	4.09	3.97	4.22	1.139
34	4.18	4.06	4.31	1.113
35	4.16	4.06	4.27	0.970
36	4.09	3.98	4.20	0.985
37	4.23	4.12	4.34	1.003
38	4.17	4.04	4.30	1.167
39	3.77	3.66	3.88	1.017
40	3.76	3.64	3.88	1.084
41	4.17	4.05	4.30	1.114
42	4.03	3.89	4.18	1.305
43	3.95	3.83	4.08	1.103
44	4.43	4.30	4.55	1.106
45	4.13	4.00	4.26	1.181
46	3.79	3.67	3.92	1.098
47	4.07	3.94	4.19	1.147
48	3.88	3.74	4.01	1.228
49	4.07	3.97	4.17	0.874
50	3.75	3.65	3.84	0.838

Content validity Analysis

Twenty experts from Vipassana meditation tradition as taught by Shri S.N Goenka were chosen for validating the appropriates of scale content. Mean age of the experts was 49 years. There were 9 males and 11 females. Average experience in Vipassana meditation of the experts was 18 years.

Items which were scored 3 or more by more than 70% of the experts were retained. Details of the scores given by each expert for the items in the scale and the corresponding content validity ratio [16] are given in Table 3. As per the criteria (at least 70% experts scoring 3 or more) all the items were retained.

Table 3. Scores given by each expert and the corresponding content validity ratio for each item of the scale

3.3 Construct validity Analysis & Reliability:

Exploratory Factor Analysis:

Preceding EFA, KMO test of sampling adequacy and Bartlett's test of sphericity was performed. The KMO correlation was 0.94, indicating the adequacy of sample size. Bartlett's test of sphericity was statistically significant (chi square=8511; df=1225; $p < 0.001$) suggesting the VWB items were significantly correlated and were suitable for factor analysis.

Exploratory factor analysis was conducted using the maximum likelihood method with oblique rotation to allow for easier interpretation of the factor structure. Based on examination of eigenvalues, scree plots, and item loading, a three-factor solution was selected. One item (item no.1) was eliminated as the factor loading was less than 0.3. Though three items cross loaded with another factor, considering the practical significance of these items we retained them to the factor with which they loaded maximum. The final scale consisted of 49 items with three factors. Factor 1, constituted 33 items. Factor 2 and factor 3 constituted 8 items each. These three factors accounted for 50% of total variance among retained items. Table 4 presents the items that loaded on each of these factors. Based on the items under three factors, names were assigned as Mindfulness & application of virtues (Factor 1), Health & Harmony with self & others (Factor 2) and Control over obstacles (Factor 3). This final three factor scale with 49 items were subjected to confirmatory factor analysis (CFA). CFA suggested a statistically significant model fit (chi square=2522; df=1124; $p < 0.001$) with Comparative Fit Index (CFI) of 0.83. The original and final scale are given in supplementary.

Table 4. Rotated factor loadings for each item of the scale

Item No.	Score given by experts (No. of Experts)	No. of experts rating 3 or more (%)	Content Validity Ratio	Remarks
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1	1(2)	2(0)	3(3)	4(4)	5(11)	18(90)	0.8	Retained
2	1(0)	2(1)	3(6)	4(5)	5(8)	19(95)	0.9	Retained
3	1(0)	2(0)	3(6)	4(5)	5(9)	20(100)	1	Retained
4	1(0)	2(1)	3(4)	4(5)	5(10)	19(95)	0.9	Retained
5	1(0)	2(1)	3(6)	4(6)	5(7)	19(95)	0.9	Retained
6	1(0)	2(1)	3(6)	4(6)	5(7)	19(95)	0.9	Retained
7	1(0)	2(1)	3(7)	4(6)	5(6)	19(95)	0.9	Retained
8	1(0)	2(0)	3(7)	4(5)	5(8)	20(100)	1	Retained
9	1(1)	2(1)	3(2)	4(3)	5(13)	18(90)	0.8	Retained
10	1(0)	2(2)	3(5)	4(8)	5(5)	18(90)	0.8	Retained
11	1(1)	2(1)	3(4)	4(7)	5(7)	18(90)	0.8	Retained
12	1(1)	2(0)	3(5)	4(11)	5(3)	19(95)	0.8	Retained
13	1(0)	2(1)	3(5)	4(10)	5(4)	19(95)	0.8	Retained
14	1(0)	2(0)	3(3)	4(8)	5(9)	20(100)	1	Retained
15	1(0)	2(0)	3(3)	4(4)	5(13)	20(100)	1	Retained
16	1(0)	2(0)	3(4)	4(8)	5(8)	20(100)	1	Retained
17	1(0)	2(1)	3(6)	4(6)	5(7)	19(95)	0.9	Retained
18	1(0)	2(0)	3(3)	4(10)	5(7)	20(100)	1	Retained
19	1(0)	2(0)	3(9)	4(7)	5(4)	20(100)	1	Retained
20	1(0)	2(1)	3(7)	4(7)	5(5)	19(95)	0.9	Retained
21	1(1)	2(0)	3(3)	4(9)	5(7)	19(95)	0.9	Retained
22	1(1)	2(0)	3(1)	4(13)	5(5)	19(95)	0.9	Retained
23	1(2)	2(0)	3(3)	4(4)	5(11)	18(90)	0.8	Retained
24	1(0)	2(1)	3(3)	4(5)	5(11)	19(95)	0.9	Retained
25	1(0)	2(2)	3(4)	4(6)	5(8)	18(90)	0.8	Retained
26	1(0)	2(2)	3(4)	4(6)	5(8)	18(90)	0.8	Retained
27	1(0)	2(0)	3(3)	4(9)	5(8)	20(100)	1	Retained
28	1(0)	2(0)	3(2)	4(10)	5(8)	20(100)	1	Retained
29	1(1)	2(0)	3(3)	4(9)	5(7)	19(95)	0.9	Retained
30	1(0)	2(0)	3(2)	4(8)	5(10)	20(100)	1	Retained

31	1(0)	2(0)	3(1)	4(9)	5(10)	20(100)1	Retained
32	1(0)	2(0)	3(5)	4(9)	5(6)	20(100)1	Retained
33	1(0)	2(0)	3(2)	4(11)	5(7)	20(100)1	Retained
34	1(0)	2(0)	3(3)	4(9)	5(8)	20(100)1	Retained
35	1(0)	2(0)	3(1)	4(9)	5(10)	20(100)1	Retained
36	1(0)	2(0)	3(1)	4(13)	5(6)	20(100)1	Retained
37	1(0)	2(0)	3(1)	4(11)	5(8)	20(100)1	Retained
38	1(0)	2(0)	3(3)	4(6)	5(11)	20(100)1	Retained
39	1(0)	2(0)	3(1)	4(11)	5(8)	20(100)1	Retained
40	1(0)	2(0)	3(3)	4(9)	5(8)	20(100)1	Retained
41	1(0)	2(1)	3(3)	4(5)	5(11)	19(95) 0.9	Retained
42	1(0)	2(0)	3(4)	4(5)	5(11)	20(100)1	Retained
43	1(0)	2(0)	3(2)	4(9)	5(9)	20(100)1	Retained
44	1(0)	2(1)	3(3)	4(5)	5(11)	19(95) 0.9	Retained
45	1(0)	2(0)	3(2)	4(9)	5(9)	20(100)1	Retained
46	1(0)	2(1)	3(2)	4(9)	5(8)	19(95) 0.9	Retained
47	1(0)	2(0)	3(2)	4(9)	5(9)	20(100)1	Retained
48	1(1)	2(2)	3(2)	4(9)	5(6)	17(85) 0.7	Retained
49	1(0)	2(0)	3(3)	4(9)	5(8)	20(100)1	Retained
50	1(0)	2(0)	3(1)	4(6)	5(13)	20(100)1	Retained

Item No.	Factor		
	1	2	3
1			
2			0.460
3			0.364
4			0.436
5			0.509
6			0.668
7			0.650
8			0.669
9			0.379
10	0.388		0.318
11	0.322		
12	0.451		
13	0.443		
14	0.356		
15	0.545		
16	0.482		0.303
17	0.454		
18	0.564		
19		0.734	
20		0.883	
21		0.804	
22		0.446	
23		0.764	
24		0.384	
25		0.378	
26		0.504	
27	0.362	0.318	
28	0.653		
29	0.589		
30	0.571		
31	0.773		
32	0.735		
33	0.594		
34	0.688		
35	0.843		
36	0.810		
37	0.709		
38	0.638		
39	0.639		
40	0.641		
41	0.641		
42	0.585		
43	0.660		
44	0.671		
45	0.583		
46	0.382		
47	0.645		
48	0.595		
49	0.597		
50	0.534		

Factor 1: Mindfulness & applications of virtues

Factor 2: Health & Harmony with self & Others

Factor 3: Control over obstacles

Table 5. Descriptive statistics of VP scale & other scales used for Convergent & Divergent Validity (n=111)

	Mean	95% Confidence Interval		SD
		Lower	Upper	
PSS	2.18	2.07	2.28	0.575
VPS	4.19	4.11	4.28	0.467
MAAS	4.78	4.63	4.92	0.779

VPS-Vipassana Proficiency Scale; PSS-Perceived Stress Scale; MAAS-Mindfulness Awareness & attention Scale

Convergent & Divergent validity:

A subset of original sample was used (n=111) for assessing the correlation between VP scale and stress & mindfulness (refer Table 5 for descriptive statistics). Based on existing evidence for relationship between stress and mindfulness with Vipassana, VP scale was tested for convergent and divergent validity with MAAS & PSS respectively. VP scale correlated positively ($r=0.6$, $p < 0.001$) with MAAS, and negatively correlated ($r= -0.5$, $p < 0.001$) with PSS (refer Table 6).

Table 6. Correlation Matrix- VP scale T1 & T2, PSS, MAAS (Test-retest reliability and Convergent & Divergent validity)

	VWB_T1	VWB_T2	PSS	MAAS
VPS_T1	—			
VPS_T2	0.912***	—		
PSS	-0.495***	-0.478***	—	
MAAS	0.595***	0.577***	-0.421***	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

VPS-Vipassana Proficiency Scale; PSS-Perceived Stress Scale; MAAS-Mindfulness Awareness & attention Scale

Reliability:

Cronbach's alpha coefficient among 49 items was high (0.9). Cronbach's alpha on sequential omission of items all remained to 0.9. Internal consistency for factor 1, factor 2 & factor 3 were 0.9, 0.8 and 0.8 respectively (refer Table 7).

For test-retest reliability, there was a strong correlation of 0.9 between the VP scale scores when repeated after a gap of one week.

Table 7: Internal Consistency

	Mean	SD	Cronbach's α
Factor-1	3.96	0.732	0.960
Factor-2	3.67	0.806	0.891
Factor-3	3.70	0.709	0.846
Overall	3.87	0.665	0.966

4. Discussion:

The purpose of this study was to develop and validate a measure to assess Vipassana proficiency from a Buddhist philosophy perspective. The final 49-item VP scale measures proficiency of Vipassana practice as elaborated in Buddhism. Overall, the findings provide strong support for the validity and internal consistency (Cronbach's alpha = 0.9) of the scale.

As expected, based on existing literature, the final scale negatively correlated with stress measured by perceived stress scale and positively correlated with mindfulness assessed by Mindfulness Attention Awareness Scale (MAAS). The three factor solution has 50% cumulative variance which is reasonable outcome for a new instrument's reliability testing as per the 50-75% cumulative variance recommended [17].

Though the scale has many items, which itself could be a reason for high internal consistency, the Cronbach's alpha did not change even after sequential omission of items, suggesting the relevance of all items.

To our knowledge this is the first comprehensive instrument to assess the Vipassana proficiency from a traditional Buddhist philosophy perspective. There are some scales which assess specific values based on Buddhist philosophy, but none of them captures proficiency comprehensively from a Buddhist philosophy perspective. Examples for such scales are the equanimity scale [18], the four immeasurable scale [19] and mindfulness [5,8,20–25]. There are some limitations of this study, however, that can be addressed in future research. Whereas this scale captures many important constructs related to proficiency from Buddhist philosophy perspective, it is possible that the constructs included are not

comprehensive. Also, the sample recruited in this study are from India which is homeland for many of the eastern philosophies including Buddhism. As Buddhism based meditation practices are followed across the world, the scale's validity in western population needs to be studied in future research. Unlike other psychometric scales which are very generic and used across meditators and non-meditators including healthy and patient population, this scale, being very specific, is applicable only among those subjects who have reasonable knowledge and practice of Buddhist meditation.

Future studies could also evaluate the scale's sensitivity to capture changes in wellbeing with changes in proficiency of vipassana practice. Apart from assessing subjective wellbeing and its correlation with proficiency of Vipassana practice, biological correlates of Vipassana proficiency can also be studied. Norms for different levels of proficiency in meditation may also be established in future studies with larger sample size.

5. CONCLUSION:

The vipassana proficiency scale is comprehensive in assessing the practice proficiency of Vipassana practitioners from Buddhist philosophical perspective. It has adequate validity and reliability for its use in Vipassana related research.

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Conflict of interest: None

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Neuroscience of Meditation: A Model to explore the evolution of consciousness

Dr. Bindu M Kuty¹

¹Senior Professor, Officer-in-charge, Center for Consciousness Studies, Department of

¹Neurophysiology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka, India. Email: bindu.nimhans@gmail.com

Abstract:

Meditation practices are intense sensory, emotional, and cognitive experiences that enhance mind-body awareness as such practices help to increase mindfulness, attention, self-awareness and cognition as well as enhance psychological self-efficacy and wellbeing. Scientific studies have provided the scientific basis of how such holistic practices enhance our capabilities in physical, mental, emotional and spiritual dimensions!

The past twenty-five years of our research studies at NIMHANS, Bangalore on meditation practices among different meditation traditions (Vipassana Meditation, Brahmakumaris Rajayoga meditation, Isha yoga, Heartfulness meditation) gave us much insight on the impact of meditation proficiency in establishing mind body harmony through reorganising the brain dynamics associated with rest, meditation practice, performing cognitive performances and during sleep. Overall, meditation practices and proficiency enhance brain resilience and cognitive capabilities through efficient modulation of brain networks and establish heightened sense of wellbeing and altruism. Such inner transformation could be a reflection of the evolution of consciousness towards experiencing a non- dual state. The Neuroscientific approach and findings associated with inner transformation will be shared in the presentation.

Sleep: A model to explore neural underpinning of first person experience

Dr. PN Ravindra¹

¹Additional Professor, Center for Consciousness Studies, Department of Neurophysiology,
National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, Karnataka,
India. Email: ravindrapinna@gmail.com

Abstract:

Neural-underpinnings associated with subjective sleep quality is highly intriguing. Experiencing sleep quality like any other cognitive ability is a complex construct that is dependent on perception, awareness and recall of sleep phenomenology. Though there are studies attempting to correlate subjective sleep quality with macro (NREM and REM sleep duration) and micro sleep architecture (sleep spindles, sleep stage transition etc) there are no consensus on what actually determines the subjective sleep quality. Probably, different sleep stages, based on their differing neurophysiological mechanism, could contribute to this phenomenological experience of having a refreshing sleep. However, primarily, restoring or increasing N3 sleep state is a therapeutic target in the management of insomnia and is associated with the subjective sense of having a refreshed sleep. Therefore, a stable N3 sleep state plays a pivotal role in experiencing sleep quality. However, given the fact that when higher cortical processing is immune to any signals during deeper sleep states, how do the percept of ‘embodied self’ get encoded and the experience of having a quality sleep emerges? The probable mechanism involved in this first-person experience of sleep quality and the effect of meditation on sleep architecture will be discussed in the presentation. The implications of this on exploring consciousness will be discussed.

Demystifying Temporo-spatial dynamics of EEG patterns to help Neurophenomenological studies across illness to wellness spectrum

Dr Arun Sasidharan¹

¹ Scientist (Neuroscience), Centre for Consciousness Studies, Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bengaluru, Karnataka, India Email.

arunsasi84@gmail.com

Abstract:

From a neuroscience perspective, the diverse phenomenological experiences associated with illness or wellness are believed to originate in the brain through complex interaction among the various brain regions as well as bodily physiological responses. A popular conventional strategy used to capture this complex interaction objectively is by studying univariate EEG patterns averaged during different mental states and conditions. However, increasingly studies have found that EEG patterns are rich with several temporal and spatial dynamics that vary across multiple features (like spectral, connectivity, entropy, etc.). Similarly, there are multiple EEG patterns associated with the same phenomenological state, within and across individuals (like alpha power decrease and increase during music listening). Therefore, we need to better understand the temporal and spatial dynamics of multivariate EEG patterns and map them to subjectively distinct states through neurophenomenological studies. However, many such attempts warrant complex analysis and research setups. This talk aims to provide a novel yet simple strategy to explore this important research area, using a simple machine learning-based approach.

Understanding chronic pain through the lenses of emotion and cognition- An EEG, ERP, and ECG study.

Dr. Vrinda Marigowda¹

¹Senior Scientist (Neuroscience), Axxonet Brain Research Laboratory (ABRL), Axxonet
System Technologies Pvt Ltd, Bengaluru, Karnataka, India.

Email: vrinda2806@gmail.com

Abstract:

Chronic non-organic pain is an unpleasant sensory and emotional experience that lasts beyond the extent of injury (>3 months). Pain perception is not just determined by physical factors but also influenced by cognitive and emotional components. That makes the condition challenging to treat. A comprehensive understanding of emotion processing, mind-body interaction, and cognitive processing would facilitate the development of effective and holistic approaches to manage and treat chronic pain conditions for better outcomes. Accordingly, in the study, we used ERP as a tool to understand emotion and cognitive processing in chronic pain subjects during the wake. Additionally, we also tried to capture the mind-body interaction of chronic pain subjects using combined data from EEG (Electroencephalogram) and ECG (Electrocardiogram), during a 'cognition-emotion conflict' task. This talk is mainly discussing the findings of cognitive and emotional processing in chronic pain subjects and mind-body interaction. And how this can be used to design a novel treatment strategy to address the chronic pain condition.

Resting state EEG data shows altered traits in advanced Isha Yoga practitioners

Mr. M. Saketh¹

¹PhD Scholar and Senior Research Fellow, Center for Consciousness Studies, Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bengaluru, Karnataka, India Email: sakethreddy21@gmail.com

Abstract:

Yogic practices, including Isha Yoga, are becoming more popular around the world, with research demonstrating their ability to reduce stress and improve well-being in a variety of populations. The true significance of any yoga or meditation practice lies in its trait effects—enduring changes in personality and way of being that persist well beyond the meditation session itself. Resting-state EEG data captures these trait effects. While there is a large body of literature, mostly in mindfulness-based practices, showing higher trait theta and alpha power in advanced meditators, there are no studies on Yogic traditions like Isha Yoga. This study aims to address this research gap and study altered traits in Isha meditators.

Our research demonstrates that Isha Yoga practises have the potential to bring about enduring alterations in resting state EEG data. These changes suggest enhancements in the attentional and self-regulatory brain networks, which are known to contribute to overall well-being. Given the increasing burden of mental health issues like stress, anxiety, and depression, there is an urgent need to integrate easy, effective, accessible, and evidence-based solutions into our public health strategies, and Isha Yoga could offer a promising avenue for this purpose.

Catching up With the Brain's Beat: Investigating Oscillatory Dynamics, Neuromodulation and Aberrant Patterns in Cognition

Mr. Rahul Venugopal¹

¹PhD Scholar and Senior Research Fellow, Centre for Consciousness Studies, Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bengaluru, Karnataka, India Email: Rahul.nimhans@gmail.com

Abstract:

The basic building blocks of the brain's information processing system are thought to be neural oscillations. They mediate and control a wide range of processes like attention, inhibition, sensory gating, decision making etc. It has been demonstrated that various mental training practices, psychedelics, and neuromodulatory techniques influence perception, cognition, and emotion by modulating these endogenous brain rhythms. The goal of the current study was to comprehensively characterise the brain oscillatory dynamics across different working memory phases in order to identify the patterns that support behavioural performance, task difficulty navigation, etc. We also looked into how abnormal neuronal oscillations arise in schizophrenia patients who have difficulties with working memory. In addition, we investigated a few transcranial alternating current (tACS) protocols that attempt to improve working memory function.

Oscillatory pattern interpretation is highly contextual. Numerous processes are in place to support cognitive functions. Thus, it becomes even more important to characterise the dynamics utilising a variety of analytical techniques in order to jointly comprehend the underlying mechanisms. For instance, in the working memory delay phase, we saw a power reduction in theta band but a frequency shift to upper alpha frequencies (10-12 Hz). In contrast, the peak frequency changed to lower alpha (8-10 Hz) during encoding and upper alpha during delay phase, while the alpha power persisted during both encoding and delay phases. The topological distribution of connectivity was adjusted to account for the increasing task difficulty, while the connection patterns maintained their relative strengths. The lack of these patterns in specific regions of the brain in Schizophrenia suggests unequivocally that abnormal oscillations are the cause of network level dysfunction.

Unmasking Dream Recall: Electrophysiological Patterns and Phenomenology of Dreams

Dr. Gulshan Kumar¹

¹PhD Scholar and Senior Research Fellow Centre for Consciousness Studies, Department of Neurophysiology, National Institute of Mental Health and Neuro Sciences, Bengaluru, Karnataka, India Email: gulshan3190@gmail.com

Abstract:

The captivating and enigmatic phenomenon of dreaming, characterised by its wide spectrum of emotional intensity, vividness, bizarreness, and narrative complexity, has been a subject of enduring fascination for researchers. Within the realm of dream research, a primary focal point has been the exploration of the neurophysiological foundations of dream recall (DR), a phenomenon marked by the conscious retrieval of dream content upon awakening. Guided by established theoretical frameworks such as the Activation

Synthesis Hypothesis, the Continuity Hypothesis, and the Activation-Input-Modulation (AIM) model, this study embarks on a journey into the intricate interplay between sleep stages, dreams, and conscious awareness. We hypothesize that the success or failure of DR is intricately linked to the electrophysiological characteristics of sleep EEG, which, in turn, resonates with Activation models. These models suggest that differences in cortical arousal within or between different sleep stages play a pivotal role in determining the likelihood of DR. The theory posits that a failure in DR could be attributed to a lower level of brain activity leading to the difficulty in recall of mental contents during sleep. Our study presents a contemporary investigation into the mechanisms underpinning sleep mentation (dreaming) and aims to illuminate the dynamic EEG characteristics in both NREM and REM sleep, providing insights into the transition from deep slumber to a wakefulness-like state during DR.

EEG based Reaction Time Prediction using Spiking Neural Network

Vivek Singh¹, Adarsh V Parekkattil¹, Tharun Kumar Reddy¹

¹Indian Institute of Technology, Roorkee

Abstract:

Drowsy driving stands out as a primary contributor to road accidents. Various approaches and methods have been documented in the literature to identify driver drowsiness. Drowsiness is characterized by a sense of weariness and a compelling urge to sleep. It manifests through a gradual decline in reaction time, diminished information processing capabilities, increased short-term memory lapses, and reduced vigilance. The Electroencephalogram (EEG), which records the brain's electrical activities, exhibits the most significant correlation with drowsiness. Consequently, EEG is widely recognised as a dependable indicator for assessing drowsiness, fatigue, and performance. In this study, we are predicting the reaction time of drivers from the EEG data by using the Spiking Neural Networks (SNN) method. Within the human brain, spikes, modeled as binary units through spiking neurons in spiking neural networks (SNN), arise when a neuron's activation exceeds a threshold due to shifts in membrane potential caused by stimulation. Utilizing SNN for reaction time prediction demonstrates notably promising results in Root Mean Squared Error (RMSE) compared to conventional baseline methods.

Keywords: Spiking Neural Networks (SNN) · Reaction Time (RT) prediction · Drowsiness · Root Mean Squared Error (RMSE).

1 Introduction

Road accidents constitute a significant cause of global fatalities, injuries, and significant economic burdens. In India in 2021, it has claimed the lives of approximately 1,53,972 individuals, inflicted injuries or disabilities on 3,84,448 more, and resulted in a staggering economic loss globally [1]. Drowsiness is characterized by a sense of weariness and a compelling urge to sleep. Drowsiness is evident through a progressive slowing of reaction time, compromised information processing, heightened instances of short-term memory lapses, and diminished vigilance. Of the various measurements, the electroencephalogram (EEG), which captures the brain's electrical patterns, demonstrates the strongest association with drowsiness. Because of its robust association with both mental and physical Singh et al. functions, EEG is considered one of the most dependable indicators of physiological signals [2]. Several methods for employing EEG to detect fatigue have been proposed in the literature [3] [4] [5] [6][7].

Spikes manifest in the human brain as neurons within spiking neural network (SNN) models surpass a threshold in activation, represented as binary units, following changes in membrane potential induced by external stimulation. These spikes convey information about external stimuli, neuron location, firing rates, and temporal patterns, offering insights into various internal computations and brain states [8]. Analysing and learning from these patterns are crucial for understanding brain processes and states using brain data. SNNs are known for their biological realism [9] in contrast to deep neural networks (DNNs)[6] [7] [10]. Spiking neurons handle spatial-temporal data through pulse coding techniques, facilitating information transmission to and from other neurons. Neurons exhibit excitatory or inhibitory characteristics based on their membrane potentials. Brain-inspired Spiking Neural Networks (SNN), recognised as the third-generation neural network, offer a more biologically faithful approach by utilising spike trains [11]. Neural connectivity and synaptic plasticity are integrated within these concepts by incorporating the dimensions of space and time [12]. Spiking neural networks (SNNs) demonstrate competitive accuracy and computational prowess akin to conventional artificial intelligence methods. Prior studies have investigated strategies to convert continuous input signals into spike trains, formulated computational frameworks modelling spiking neurons, and devised mechanisms facilitating connection establishment and learning within SNNs [13].

Spiking neural networks (SNNs) has gained widespread recognition as an appropriate paradigm for the processing of spatio-temporal brain signal data (STBD), encompassing EEG, fMRI, and multisensory streaming information. In this context, the NeuCube computational architecture [14] stands out as a novel SNN approach. NeuCube represents a flexible software/hardware development platform designed specifically to facilitate the creation of prototype systems rooted in spiking neural networks (SNN). These SNN systems serve the purpose of data mining, pattern recognition, and predictive data modelling, particularly with complex and extensive datasets, including those with temporal, spatial, or spectro-temporal dimensions (SSTD).

Applications developed with NeuCube follow the architectural model of a Spatio-Temporal Data Machine (STDM). Understanding that NeuCube is not a quick fix for all data-related challenges is essential. Instead, it offers a sophisticated framework of methods that enable the meticulous design and implementation of effective solutions to these challenges. Achieving this entails carefully selecting and testing the most appropriate methods and parameters for an STDM. This process may be time-consuming, but the results can be highly impressive in terms of both accuracy and comprehension of the data. An STDM consists of three key components: 1. An input section responsible for encoding input data into spiking sequences. 2. An SNNcube component that employs unsupervised learning to capture spatio-temporal patterns in the input data. 3. An evolving EEG based Reaction Time Prediction using Spiking Neural Network 3 output section designed for classification or regression tasks. This output section is trained in an incremental and adaptive manner, either in a supervised or semi-

supervised mode, to classify (or calculate) the patterns recognised by the SNNcube into output classes or regression values. NeuCube generates diverse models for EEG data using distinct information processing approaches [14]. These include:

- Employing a spatial structure mirroring brain atlases to approximate the areas in the brain from which EEG data is gathered.
- Implementing a spiking information processing paradigm to characterize and study EEG data.
- Utilizing brain-inspired learning principles to discern patterns within EEG data.
- Evolving the model by progressively integrating newly recognized EEG data patterns in line with principles resembling cognitive development in the brain.

These principles collectively establish NeuCube as a well-suited SNN architecture for unravelling complex and potential EEG data patterns. In this study, the NeuCube SNN architecture [14] is applied to drivers' drowsiness data to extract reaction time, enabling a better prediction of reaction time for drowsy drivers.

The main contributions of the proposed methodology through this paper:

- Integration of an innovative Spiking Neural Network (SNN) implementation.
- Selection of the precise and optimised parameters of the Spiking Neural Network (SNN) models for predicting driver reaction times using EEG data.
- Compare SNN-based prediction models against standard approaches to establish SNN's superior predictive accuracy, measured by RMSE metrics.

The rest of the paper is organised as follows. A detailed description of the methodology used is presented in section II. Then, the analysis of the results for the proposed approach and discussion is depicted in section III. Finally, we summarise all the research in the conclusion section.

2 Methodology and Implementation details

2.1 Dataset Details [15]

Ethical Approval The study received approval from the Institutional Review Board of the Veterans General Hospital in Taipei, Taiwan.

Participants The dataset consists of EEG recordings from 12 university students who volunteered for the data collection. Their average age was 22.4 years, with a standard deviation of 1.6. These participants were National Chiao Tung University (NCTU) students in Taiwan. In total, 62 EEG data sets were collected from these participants. Singh et al. EEG Signal Collection EEG signals were acquired using the Scan SynAmps2 Express system. EEG signals were collected from 30 active electrode sites, positioned in accordance with a modified international 10–20 electrode montage system at a sampling rate of 250 Hz. The 30 signals were from the Fp1, Fp2, F7, F3, Fz, F4, F8, T3, C3, Cz, C4, T4, T5, P3, Pz, P4, T6, O1, O2, AF3, AF4, FC1, FC2, CP1, CP2, PO3, PO4, F1, F2 and Oz electrodes.

Data Collection Duration EEG recordings were gathered during a span of five months to explore the electroencephalogram (EEG) correlation of performance and attention changes under fixed conditions of real-world drowsiness.

2.2 The Proposed Method: Neucube SNN Architecture

N. Kasabov presented NeuCube, a 3-D SNN reservoir that is physiologically inspired by the biological brain and is capable of performing both classification and regression tasks on complicated signals based on supervised and unsupervised learning. NeuCube constitutes a computational model with three primary functional components: an input spike encoding module, a 3D SNN reservoir module (SNNr), and an output module.

A signal denoted as $x(t)$, comprising spatial and temporal/spectral aspects within a defined time window, undergoes collection and spike encoding through an encoding function $a: P \times R^n \Rightarrow P \times B^n$. This process results in the transformation of the signal into a discrete time series represented by sparse binary spikes, commonly referred to as spike trains. Following this step, the encoded input spike train is provided as input to the SNNcube. Through an unsupervised learning approach, the SNNcube discerns the relationships among input signals. Consequently, this learning process enables the SNNcube to establish spatial and temporal connection patterns. The acquired spatio-temporal patterns are then transformed into another signal using a specific function. $b: P \times B^n \Rightarrow P \times B^s$, which integrates the SNN cube's dynamic spiking behaviour. Because of the SNNcube's internal architecture and characteristics, each input sample causes the SNNcube to undergo distinct dynamic responses, which are then recorded by a function. $c: P \times B^s \Rightarrow P \times R^q$ establishing a distinct spatio temporal connection pattern for every input sample. Eventually, a readout function $d: R^q \Rightarrow \{0, 1, \dots, N\}$ undergoes training by utilizing the spatiotemporal patterns induced by input data samples within the SNNcube, representing N input classes. Ultimately, NeuCube becomes proficient in predicting the class e of a new input signal x through the function $e(x) = d(c(b(a(x))))$. The analysis processes with NeuCube described above are depicted in Fig. 1, and the NeuCube-M1 Module application user interface is presented in Fig. 2.

2.3 Spatio-temporal signal encoding

The input module's primary responsibility is to convert continuous time series data into discrete sparse spike trains. Thus far, NeuCube has integrated four EEG based Reaction Time Prediction using Spiking Neural Network

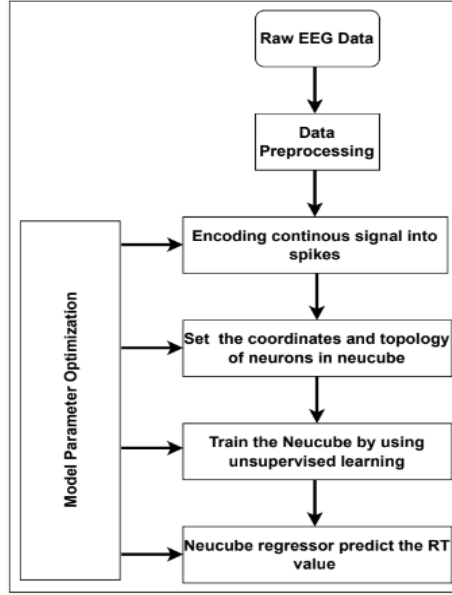


Fig. 1. Analysis processes with Neucube

different encoding methods: Step Forward (FS), Moving Window (MW), Bens Spiker Algorithm (BSA), and Thresholding Representation (TR). Different spike decoding methods display specific attributes when converting continuous input time series into sparse spike trains[13]. This work uses the Thresholding Representation (TR) spike encoding approach to improve the signal representation. Using the threshold value, spikes are generated in accordance with spatio-temporal EEG data, which consists of continuous real values. Positive spikes are produced when the signal changes over the spike threshold (0.5); negative spikes are produced when the signal changes below the threshold value, otherwise no spikes are produced as shown in Fig 3.

The algorithm operates in the following manner: At each time step τ , it calculates the difference $\Delta e = e(\tau) - e(\tau - 1)$ between the current and preceding values of the EEG signal, comparing this difference to a predefined threshold. A spike is generated when the absolute difference exceeds the threshold. The polarity of Δ determines the spike's nature: a positive value (+1) indicates an excitatory spike as the signal ascends, a negative value (-1) represents an in Singh et al.

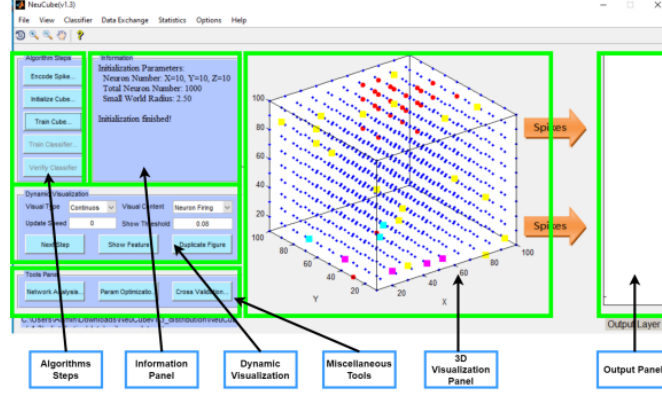


Fig. 2. User Interface for the NeuCube-M1 Module

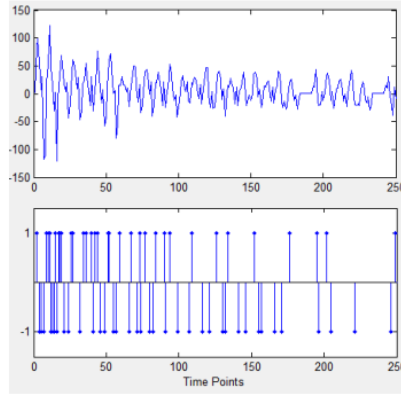


Fig. 3. Threshold-based representation of the input EEG data

inhibitory spike as the signal descends, and a value of zero (0) signifies no spike when the absolute difference is below the threshold. Once encoding is finished, the spike trains are consistently inputted into the SNNr. The SNNr, a component of NeuCube, adopts a three-dimensional network structure with recursive connections linking leaky-integrate and fire model (LIF) spike neurons. The organization of neurons in SNNr can be categorized into two groups: a brain-shaped or cubic topology structure. The selection of neuron coordinates during initialization and specific input neuron mapping techniques determines the topology. For this study, the brain-shaped neuron topology is employed, utilizing input neuron mapping and neuron coordinates derived from the Talairach template.

The Talairach stereotactic atlas placements set 1471 neurons in total, of which 30 are input neurons. Closer neurons are more likely to be linked than neurons farther apart once the neuron locations have been determined. This is known as a small world connectome (SWC), where synaptic connections are started. For every neuron pair $N_j = (x_j, y_j, z_j)$ and $N_i = (x_i, y_i, z_i)$, the Euclidean distance is computed, then, a connection probability $P_{i,j}$ is calculated according to Equation

$$P_{i,j} = \begin{cases} C * \exp\left(-\left(\frac{d_{i,j}}{\lambda}\right)^2\right) & \text{if } d_{i,j} \leq d_{thresh} \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

The parameters d_{thresh} , denoting the maximum relative distance for interconnected neurons, C representing the maximum connection probability, and defining the connection radius for small-world networks were investigated. A value of $\lambda = 2.5$ units was identified as the most optimal for the effective initialization of the 3D cube.

2.4 Utilizing Spike Timing-Dependent Plasticity (STDP) for Unsupervised Training

We employ the classic Hebbian approach, in which weight changes are computed according to relative spike timing. From a synapse's point of view, potentiation happens when a presynaptic spike is quickly followed by a postsynaptic spike; reversing this spike ordering results in depression. This weight change's magnitude is determined using 2, where τ is the period of time that plasticity is active and A defines the learning rate. The plastic update only takes into account subsequent pairs of spikes, and the weight change is multiplicative, meaning that the initial weight is scaled within the bounds $w_{min} \leq w \leq w_{max}$. Figure 4 illustrates the weight change in STDP.

$$\frac{\Delta w_{pre}^{post}(\Delta t)}{\Delta w_{pre}^{post}} = \begin{cases} A_+ \cdot \exp\left(-\frac{\Delta t}{\tau_+}\right) & \text{if } \Delta t > 0 \\ -A_- \cdot \exp\left(\frac{\Delta t}{\tau_-}\right) & \text{if } \Delta t < 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

All things considered, NeuCube uses STDP learning to reinforce synapses that contribute to the formation of neuronal connectivity sets particular to a class and weaken connections that have no bearing on the formation of neuron patterns distinct to a class. As a result, distinct spatiotemporal correlations are identified and magnified. Fascinatingly, the SNNcube is able to isolate class-specific firing neuron sets using STDP-learning and filter class-specific

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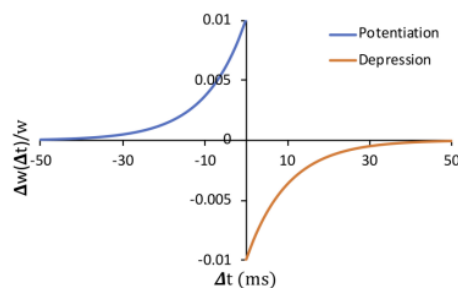


Fig. 4. Synaptic weight modification (δw) attributed to a single pre and post – synaptic spike pair, as influenced by the spike time difference (δt) in Spike Timing – Dependent Plasticity (STDP) [16]. spatiotemporal properties from EEG data thanks to the intricate connection and spatially meaningful neuron structure.

In the context of neural network training, specifically utilising unsupervised Spike-Timing Dependent Plasticity (STDP) rules, the learning process involves the modulation of connection weights between neuron pairs. STDP operates based on Hebbian principles, incorporating long-term potentiation (LTP)

and long-term depression (LTD). When a temporal disparity between a presynaptic neuron and a postsynaptic neuron reaches its maximum, resulting in a positive time difference, the associated connection weight diminishes; conversely, an opposing temporal peak leads to an increase in the connection weight.

2.5 Regression Module

The third step, denoted as $c: P \times B^s \Rightarrow P \times R^q$, embodies the realisation of a classification/regression function within the SNNcube. This step involves the conversion of SNNcube activity into output classes through the application of a readout function, marked as $d: R^q \Rightarrow \{0, 1, \dots, N\}$. Specifically, in this phase, the dynamic evolving SNN (deSNN) model is employed due to its proven effectiveness in both spatial and temporal pattern recognition and precise spatial temporal event prediction. The deSNN network operates by comparing the connection weights of previously trained neurons with the synaptic weights of a newly constructed output neuron, reflecting the novel spatial-temporal pattern for recall. This algorithm consists of two distinct stages: the training and subsequent classification/regression phases. Throughout the training phase, new output neurons are generated and linked to reservoir neurons for each training sample, their respective spike trains are then integrated into the reservoir for further processing. The deSNN employs the rank order (RO) Eq. 3 rule for establishing the initial weights of connections linking the reservoir with the output neuron:

$$w_{j,i}(t) = \alpha \cdot \text{mod}^{\text{order}(j,i)} \quad (3)$$

The equation defines several variables: $w_{j,i}$ denotes the weight between a presynaptic (reservoir) neuron j and a postsynaptic (output) neuron i ; $\text{mod} = (0, 1)$ represents a modulation factor determining the initial spike's order significance; serves as a learning parameter, often set to 1 in certain cases; $\text{order}(j, i)$ indicates the order or rank of the initial spike transmitted from neuron j to neuron i relative to all reservoir neurons, initially set at zero and incrementing proportionally to other reservoir neurons' spike orders. The deSNN algorithm adjusts synapse $w_{j,i}$ throughout the simulation time based on:

$$w_{j,i} = \begin{cases} d_+ & \text{if } j \text{ spikes} \\ d_- & \text{otherwise} \end{cases} \quad (4)$$

where d_+ and d_- are both positive and negative drift parameters. After adjusting for weight, the supplied data is used to train the K-nearest neighbors (KNN). The same learning method is applied to each new sample in the regression phase, and the new validation sample is allocated to the class that the KNN predicts—which may also be utilized for regression function[17]. Figure 5 shows how a classification neuron is created and how the KNN assigns it to a class. The KNN may use several characteristics to

fit the data. The total amount of spikes per reservoir neuron, the starting or final weight vectors, or a user-specified mix of the aforementioned can all be used.

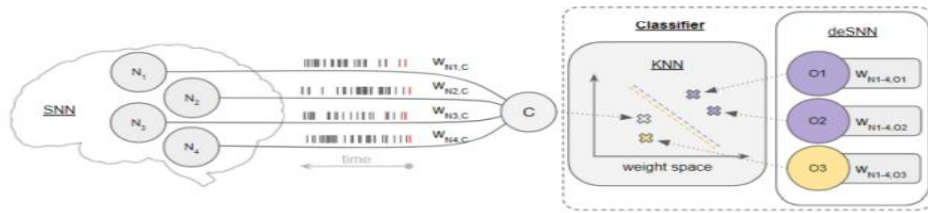


Fig. 5. The classification process involving output neuron C entails the calculation of weights between reservoir neurons N_i and Classification neuron C. The resultant weight vector is compared with all weight vectors in the deSNN using a KNN classifier. The class of the closest output neuron O_j determines the sample's class prediction [16].

2.6 Implementation

The Temporal Contrast (Threshold-based) encoding approach was applied to encode the real-valued EEG data into spike trains. Then, using a small-world connection rule, a $10 \times 10 \times 10$ Neucube was created and initialised to make it easier to understand the temporal patterns present in the spike trains. All of the input variables are mapped into the Neucube using a graph-matching method to guarantee that the time-dependent variables are mapped into the closest input neurons. After STDP learned the synaptic weights, the input data was propagated, and the weights were fixed. After establishing the weights, the spike trains were reintroduced into the (SNNc) to extract the firing state vector for each neuron, which represents the original input signals' altered characteristics for following learning phases. In order to discover the underlying temporal patterns, this firing state vector was subsequently input into a Dynamic Evolving Spike Neural Network (deSNN) classifier. A set of validation data was used to evaluate the system's validity and effectiveness after thorough training.

3 Results and Discussion

The root mean square error (RMSE) values for each subject are presented in Table 1. Analysis of the table suggests that subjects with multiple data sessions exhibited notably accurate reaction time predictions by the proposed SNN model. Specifically, for subjects with more than two sessions, the model demonstrated significantly reduced RMSE. Consequently, it is evident that employing the proposed SNN model with four or five sessions of data enhances the accuracy of reaction time prediction, indicating its potential superiority in predictive performance.

In Table 2, a comprehensive evaluation of aggregate performance reveals the SNN approach as markedly outperforming the LGN, ADG, and BP-based neural network regression methodologies in terms of RMSE. Notably, when applied to the specific task of assessing EEG drowsiness, the proposed

SNN exhibited superior performance compared to the Lagrangian (LGN), Adagrad (ADG), and Backpropagation (BP)-based Neural Network (NN) approaches. Particularly significant among its advantages is the SNN's proficiency in capturing nonlinear relationships within EEG drowsiness data, allowing for more accurate regression predictions.

In evaluating the performance of learning algorithms, the Root Mean Square Error (RMSE) serves as a crucial metric, providing insight into the accuracy and precision of predictions. Among the algorithms under consideration— Backpropagation (BP), Adaptive Gradient Descent (ADG), and Local Gradient Normalization (LGN)—distinct levels of effectiveness are observed. BP demonstrates a commendable RMSE of 0.0853, indicating relatively accurate predictions. ADG, with an RMSE of 0.0879, closely trails behind, showcasing its competence in minimizing prediction errors. LGN, on the other hand, boasts the lowest RMSE among the three at 0.0751, suggesting enhanced predictive accuracy compared to BP and ADG. However, it is noteworthy that a novel algorithm, the Spiking Neural Network (SNN) architecture in Neucube, outshines its counterparts with a significantly lower RMSE of 0.0586. This notable difference underscores the potential superiority of the proposed SNN algorithm, signaling its ability to

Table 1. The Distribution of Subjects-Number of Sessions-Events Count and their corresponding RMSE values

SUBJECT ORDER	SUBJECT NAME	NUMBER OF SESSIONS	EVENTS COUNT	RMSE
1	Subject 01	5	4827	0.02
2	Subject 02	2	2028	0.02
3	Subject 04	1	1083	0.12
4	Subject 05	4	6378	0.01
5	Subject 06	1	1077	0.07
6	Subject 09	3	2112	0.03
7	Subject 11	1	1290	0.02
8	Subject 12	2	1869	0.13
9	Subject 13	2	2244	0.04
10	Subject 14	2	2181	0.14
11	Subject 22	4	5022	0.03
12	Subject 23	1	1317	0.04
13	Subject 31	2	3618	0.09
14	Subject 35	2	3285	0.01
15	Subject 40	2	3921	0.04
16	Subject 41	5	6747	0.02
17	Subject 42	2	2430	0.00
18	Subject 43	3	5709	0.03
19	Subject 44	4	7269	0.04
20	Subject 45	2	4023	0.09
21	Subject 48	1	1050	0.06
22	Subject 49	3	3102	0.02
23	Subject 50	2	2085	0.02
24	Subject 52	1	717	0.16
25	Subject 53	3	3654	0.04
26	Subject 54	1	615	0.13
27	Subject 55	1	1923	0.15

Learning Algorithm	RMSE
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BP	0.0853
ADG	0.0879
LGN	0.0751
SNN (Proposed)	0.0586

Table 2. Evaluation of the regression performance using different neural network regression models make more precise predictions and potentially outperform existing methods in various applications.

4 Conclusion

This paper discusses the use of Spiking Neural Networks (SNNs) for detecting drowsiness using Electroencephalogram (EEG) data. The above findings collectively highlight the SNN's prowess in handling complex temporal data, showcasing its potential as a frontrunner in predictive modeling, particularly in tasks involving reaction time prediction and EEG-based cognitive state assessment. The SNN's capacity to discern subtle nonlinear patterns within EEG data offers a promising avenue for enhancing the accuracy and reliability of predictive models in real-world applications. As such, this research substantiates the SNN's position as a powerful tool in cognitive state analysis, paving the way for further exploration and implementation in diverse fields reliant on accurate predictive modeling.

Acknowledgement

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Cerebral Rhythm Analysis and CNN Classification of Meditators and Novices using Morlet Wavelet

Soniya Usgaonkar^{1,2}, Damodar Reddy Edla¹, Soham Chauhan¹

¹Department of Computer Science and Engineering, National Institute of Technology Goa,
Farmagudi, Ponda, Goa, India-403401,
soniya_usg@nitgoa.ac.in,
dr.reddy@nitgoa.ac.in,sohamdchauhan2023@gmail.com

²Information Technology Department, Goa College of Engineering Farmagudi, Ponda, Goa, India-
403401

Abstract:

Deeply rooted in Indian culture and tracing back to Vedic times, the practice of meditation has been a significant aspect of spiritual, mental, and physical well-being. In this research, a meticulous preprocessing pipeline, including artifact removal techniques, and spectral and spatial filtering, is employed. The Morlet Wavelet was used to generate the time and frequency images in alpha and theta bands of EEG. Two frequency bands, theta (4-8 Hz) and alpha (8-12 Hz), are investigated using a Convolutional Neural Network (CNN) architecture for classification. Performance metrics including accuracy, precision, recall, and area under the curve (AUC) are used to evaluate the model's classification ability. The result of Alpha brainwave activity shows a significant increase in expert meditators, aligning with the existing literature on the association between alpha band activity and meditation. Theta wave results indicate inconsistent achievement of deep meditation states due to experimental factors.

Keywords: Electroencephelography (EEG), meditation, Convolution Neural Network (CNN), Morlet wavelet

1 Introduction

In Sanskrit, the word dhyana means meditation[1][2] . Rooted in the Latin word 'mediatri' the term "meditation" signifies the profound act of engaging in contemplation and reflection[3]. Throughout the ages, meditation has been recognized as a transformative practice, nurturing inner stillness, fostering mindfulness, and unveiling the path to self-discovery and personal growth. In India, meditation originated and developed within the traditions of Hinduism, particularly within the yogic and philosophical systems. Prominent research findings indicate that the cognitive processes engaged during meditation practices help in lowering blood pressure, improving our immune system, and helps to

decrease our perceptual habituation and reallocation of attention[4]. Negative emotions such as sadness, anger, fear, shame can lead to long-term effects such as depression and also arise in the form of chronic body pain[5] which can be reduced by practicing meditation. Thus meditation is a link between the brain, body, and emotions [4]. Practicing meditation regularly can give us healthy and blissful living. Various techniques of meditation encompass a diverse array of contemplative practices such as Focused attention meditation (FA), Mantra meditation practices, Nondual meditation, loving kindness and compassion meditation (LKM) etc[6][7]. Though the styles of meditation are different, most of the styles are based on concentration of breath. By focusing on the breath in meditation, practitioners can tap into a powerful tool for cultivating mindfulness and enhancing their overall meditation experience[4][5][6].

Electroencephalography (EEG) plays a very important role in studying meditation in neuroscience. It is a non-invasive technique that has been widely used to observe how the electrical activity of the brain changes during meditation. Since the human brain is complex and composed of billions of neurons, accurately analyzing the rhythmic behavior of brain signals is a challenging task. Within the realm of existing literature, numerous classification techniques have been proposed to effectively categorize EEG patterns into distinct groups based on different cognitive activities. In our particular case, we are interested in classifying individuals into two groups: experts and novice meditators. The majority of these classification algorithms operate on the inherent characteristics of the brain. However, the process of feature extraction from EEG signals can often be challenging due to various factors, including the substantial data dimensionality, nonlinearity, and non-stationarity of the signals[8].

The existing literature on differentiating between meditators and non-meditators has explored the use of various machine learning classifiers[9], including Convolutional Neural Networks (CNN). However, there is limited work that specifically leverages the output of Morlet Wavelet, which generates grayscale images representing time and frequency domain information from EEG signals. In this context, the paper highlights the promising potential of Morlet Wavelet as a valuable tool for EEG signal analysis. The key novelty lies in generating time frequency images in the alpha and theta frequency bands, which serve as input to a CNN classifier.

In the subsequent section II, discusses preprocessing methods and generation of time-frequency image generation and CNN classification which is depicted in 1 . Finally, we conclude the paper with results and discussions, and conclude in sections III and IV respectively.

2 Methodology

2.1 Dataset

The datasets were collected using a 64-channel Biosemi EEG system at the Meditation Research Institute (MRI) in Rishikesh, India. In this meditation experiment, 24 participants (subjects) were involved. They practiced meditation and



Fig. 1. Block diagram of EEG data preprocessing

were intermittently interrupted every two minutes to assess their concentration level and occurrence of mind wandering [11]. The participants in the experiment were from the Himalayan Yoga tradition and were grouped into two categories based on their experience and daily practice hours into experts and novices. Participants who practiced 2 hours of meditation daily for 1 year or more were assigned to the expert group and others who were trained in this technique but lacked the consistency in practice were assigned to the novice group. Out of 24 subjects, 12 subjects were experts and the rest 12 were novices or new meditators. Prior to the commencement of the study, all participants willingly granted written consent to partake in the research. Furthermore, participants confirmed that they were not taking any medications that could potentially influence their ability to focus. The details of processing are explained in section 2.2.

2.2 Data Preprocessing

The dataset is in Brain Imaging Data Structure format which is a standardized format for the organization and description of neuroimaging and corresponding behavioral data. We performed preprocessing using Matlab and EEGLAB software [12]. The dataset was down-sampled to 256 Hz. A High pass filter was applied using a short infinite impulse response (IIR) filter at 2 Hz with a bandwidth of 0.7 Hz and order of 6. Then the data was average referenced [11]. Bad channels were rejected using Artifact Subspace Reconstruction (ASR). On average 0 to maximum 17 of bad channels were removed per subject. Independent Component Analysis (ICA) was then performed using extended Infomax runica.m. ICA can separate the EEG data into statistically independent components[12], some of which represent neural sources while others represent artifacts. Common artifacts like eye blinks, muscle activity, and electrode noise can be isolated and 4 Soniya Usgaonkar, Damodar Reddy Edla, and Soham Chauhan

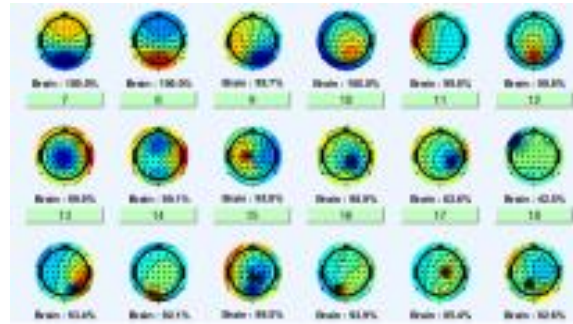


Fig. 2. Snapshot of ICA decomposition

removed from the EEG signal by discarding the corresponding components. The decomposition of ICA components is shown in Fig 2 of one expert subject and a more detailed view of single ICA component is shown in Fig 3.

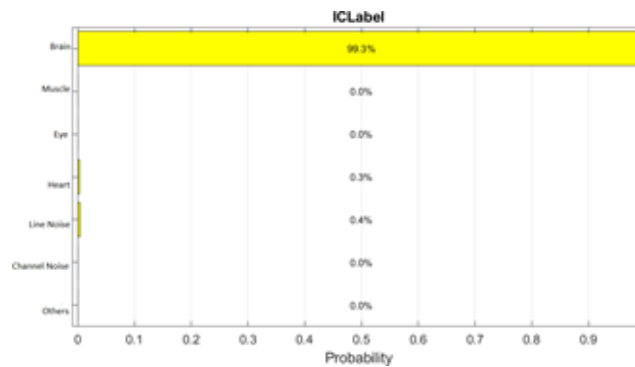


Fig. 3. Percentage of ICLabel for single ICA component

Fig. 3 gives a percentage of line noise, channel noise, eye blinks, muscle artifacts, and other noise for each component. So each component was visually inspected and removed if brain data was less than the total of different types of noises. In Fig. 3, since brain data is very high (99.3) and noises are almost nil, it is retained. Fig. 4 shows the Power Spectrum of the IC2 component. The power spectrum refers to the distribution of power or energy across different frequencies in the electrical brain activity recorded by the EEG.

2.3 EEG Time Frequency Image Generation

Data was epoched using a linearly spaced time window based on the duration of data and the desired number of time windows (200 in this case). After generating the time window and frequency parameters, the Morlet Wavelet is applied. Morlet Wavelet decomposition is a time-frequency analysis technique that decomposes a signal into its constituent frequencies across time [11]. By convolving the signal with a set of complex Morlet Wavelets, it estimates the power of different

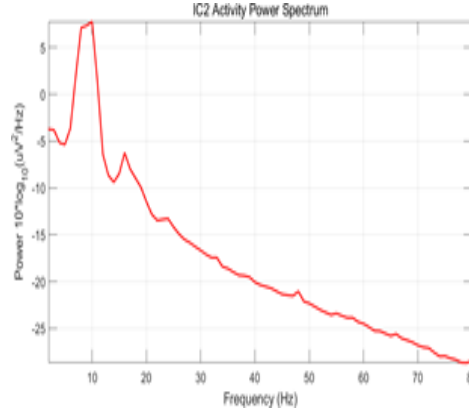


Fig. 4. Power spectrum of IC2 component

frequency components at each time point. This allows for the exploration of how the power of different frequencies changes over time. The time-frequency maps are generated across each frequency band. The process repeats for each subject and frequency combination. For example Fig. 5 shows grayscale time frequency image for a novice subject at a frequency 10.5 Hz in band range alpha (8- 12). In each band we had 10 such images for each subject for different frequencies. Since there are 24 subjects, there are total of $10 \times 24 = 240$ images across each band (240 in each 4-8 and 8-12 respectively). Thus we created a total of 480 images in total. This implementation is done using MNE python library[13].

2.4 Classification across frequency bands

Implementation is done using a CNN architecture for image classification using the TensorFlow framework [14]. The datasets were divided into two categories based on frequency ranges such as theta (4-8)(dataset 1), alpha (8-12)(dataset 2)[15]. We have made an attempt to study how brain waves change in these frequency bands for expert and novice meditators.

For each frequency range category, we loaded the corresponding dataset of images. These datasets were organized based on different frequency ranges. The CNN architecture consisted of two main types of layers, convolutional layers and fully connected layers. The convolutional layers were responsible for capturing patterns and features from the images. By applying various filters to the input images (generated using Morlet Wavelet), these layers learned to recognize relevant visual characteristics.

After each convolutional layer, we used a max-pooling layer to down sample the extracted features, reducing their spatial dimensions. Following the convolutional and max-pooling layers, we flattened the output into a one-dimensional vector. By employing a combination of dense layers with rectified linear unit (ReLU) activation, the network progressively transformed the input data, ultimately enabling it to make accurate predictions [8]. To train the model, we used an optimization algorithm called Adam with a learning rate of 0.001 [16][17]. This algorithm adjusted the model's internal parameters to minimize the error between predicted and true labels. The models were trained over 4 epochs, with each epoch representing one complete pass through the entire dataset. We performed classification for two

datasets one for alpha and another for theta

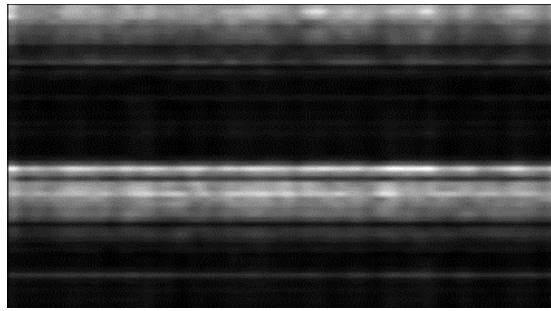


Fig. 5. Time frequency map of novice meditator

during training into expert and novice meditators. We conducted performance evaluations on these datasets during the training process. The following section provides a comprehensive analysis of the obtained results.

3. Results and discussion

The main aim of this paper is to gain insights into how brain waves change during meditation and to classify individuals into the respective meditator categories based on their brain activity patterns.

The EEG data used in this paper is for twenty-four subjects aged between 25 and 45 years comprising of 3 females and 21 males. EEG data have been recorded from 64 channels following 10–20 international systems. The participants' well-being and absence of any neuropsychological disorders have been ensured. Prior to the experiment, all volunteers were informed about the experimental procedures.

	Dataset 1	Dataset 2
Frequency	theta(4-8)	alpha(8-12)
Loss	2.9747	0.4471
Accuracy	0.39606	0.78682
Precision	0.4019	0.80092
Recall	0.4685	0.72083
AUC	0.3290	0.8911

Table 1. Performance Parameters for Classification Mode

We followed the standard pre-processing strategy as explained in section II and used Wavelets to extract time-frequency information from the signals.

Time-frequency analysis is important for understanding complicated signals and finding important information in many different applications. Traditional Fourier analysis lacks the ability to localize both time and frequency simultaneously, limiting its effectiveness in dealing with non-stationary signals like EEG. Wavelet transform, including Morlet Wavelets, overcomes this limitation and allows for time-frequency localization, making it a preferred choice for time-frequency analysis. The Morlet Wavelet is particularly effective in capturing transient events and localizing signal features in both the time and frequency domains. This justifies our choice of use of Morlet Wavelet in our paper.

For two frequency range category, We loaded the corresponding datasets of images. These datasets were organized based on frequency groups ranging from 4- 8 Hz. and 8-12 Hz details of which are explained in section II under generation of EEG Morlet images. Further, our implementation involved the construction of a CNN architecture with convolutional and fully connected layers. The use of Adam optimizer helps to reduce the computational time and uses fewer parameters for tuning.

Table I shows the performance parameters of 2 datasets across different frequency bands such as theta (4-8Hz) and alpha (8-12Hz) using CNN model. The model's performance was evaluated using various evaluation metrics, including accuracy, precision, recall, and area under the curve (AUC) and loss in training phase as shown in Table I. These metrics are explained as follows:

$$Accuracy = \frac{EE + NN}{EE + NN + NE + EN} \quad (1)$$

$$Precision = \frac{EE}{EE + NE} \quad (2)$$

$$Recall = \frac{EE}{EE + EN} \quad (3)$$

Where EE represents expert class classified as expert by the classifier, NN represents novice class which is categorized as novice by the classifier, NE represents novice class observed as expert by the classifier, EN represents expert class which is classified as novice by the classifier.

Precision is a metric that gauges the accuracy of positive sample classification by measuring the ratio of correctly identified positive samples to all samples classified as positive. A higher precision indicates a lower false positive rate. In our results, the precision values for datasets 1 is 0.4019 and datasets 2 is 0.80092. Accuracy provides a metric of how well the classification model performs in accurately assigning class labels to given data. It is a measure which evaluates overall performance of a model. Higher accuracy values indicate better overall performance. The accuracy values for datasets 1 is 0.39606 and for datasets 2 is 0.78682. Loss represents the error or mismatch between the predicted

and actual values in the classification model. Lower loss values indicate better model performance. The loss for dataset 1 is 2.9727 and for dataset 2 is 0.4471. Lower loss values indicate a better fit of the model to the data. The loss function used in this model is binary cross entropy [18]. Recall, also known as sensitivity or true positive rate, measures the proportion of correctly classified positive samples out of all actual positive samples. Higher recall values indicate a lower false negative rate. In our case recall for datasets 1 is 0.4685 and for datasets 2 is 0.720835. Area Under the Curve (AUC) measures the performance of a classification model by evaluating its ability to discriminate between different classes. A higher AUC indicates better discrimination between classes. For datasets 1 AUC was 0.3290 and for datasets 2 it was 0.8911. The reason for considering the datasets only in alpha and theta lies in the fact that during meditation these bands are active. Also previous literature studies are inline with our statement [8]. The alpha band (8- 13 Hz) is often associated with a relaxed, calm state and is frequently observed during meditation. Good performance of classifiers in the alpha band suggests that there may be distinct patterns or features in the alpha band that reliably differentiate between expert and novice meditators. Our findings suggest, significant uptick in alpha brainwave activity within our expert meditation group. This provides valuable evidence for its potential involvement in the processing and synthesis of somatosensory information. This aligns with the existing literature on the relationship between alpha band activity and meditation [11].

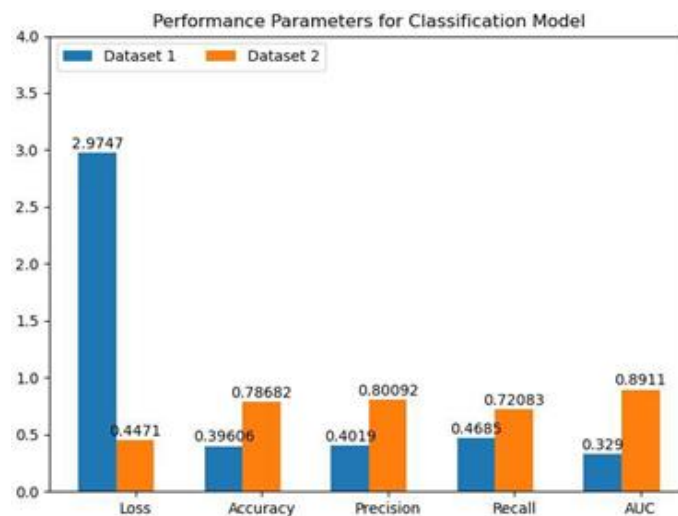


Fig. 6. Performance parameters for CNN model

Theta waves (4-8Hz) are characteristic of a deeply relaxed yet focused state of consciousness. They are often associated with access to subconscious and intuitive processes, enhanced creativity, and profound inner experiences. Performance of the classifier during training is poor in this band. This result is an indication that no mediator could attain a deep state of meditation. The reason behind this is due to the experimental procedures followed during data recording. Sampling probes were used to collect real-time data on participants' mental experiences. The experience-sampling probes took the form of pre-

recorded vocalized questions. During the questionnaire participants were asked to rate the depth of their meditation, the frequency of mind-wandering, and their level of drowsiness on a scale from 0 (low) to 3 (high). These probes were presented randomly at intervals ranging from 30 to 90 seconds throughout the study's duration. In the course of the experiment, each participant was exposed to a minimum of 30 experience-sampling probes.

4. Conclusion

In this research we have analysed the brain signals in different frequency bands such as alpha and theta. Morlet Wavelet was used which estimated the power spectral density of the data across the time-frequency domain. For each frequency range category, we loaded the corresponding dataset of images. Overall, our implementation involved the construction of a CNN architecture with convolutional and fully connected layers. By training and evaluating the model on frequency specific datasets, we aimed to perform binary classification into expert and novice classes and gain insights into the relationship between frequency ranges and image features. The ability to classify individuals into expert and novice categories based on EEG signals opens up possibilities for neurofeedback training. Future research could explore how biofeedback mechanisms can help novices improve their meditation skills by providing real-time information on their brain activity and guiding them towards the patterns associated with expert meditators.

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PEDNet: Preprocessed Ensembled Deep Network for Diagnosis of Epilepsy Seizures using EEG image representations

R Murugan¹, D N Kiran Pandiri¹,

Ananya Bhattacharjee¹, Sonal Yadav¹, Tripti Goel¹

¹Biomedical Imaging Laboratory (BIOMIL), Department of Electronics and Communication Engineering, National Institute of Technology Silchar, India

¹Email : murugan.rmn@ece.nits.ac.in

Abstract:

Epilepsy is a neurological disorder induced by brain neurons' spontaneous activation and discharge. Neurophysiologists' manual identification of seizures and their complex waveforms in electroencephalography (EEG) is time-consuming, laborious, and prone to human error. The proposed model introduced an automated epilepsy seizure detection system utilizing a continuous wavelet transform-based pre-processed deep ensemble neural network. The EEG signals are converted into time-frequency image representations, termed scalograms, which are then fed as input to the ensemble model containing Densenet 121 and EfficientNet B2. The fused features are then passed through the global average pooling layer followed by the softmax layer, which yields the multi-class classification of pre-ictal, interictal and ictal classes. The proposed model ensured no misclassification cases by obtaining 100% accuracy, recall, precision, F1 score, and AUC score. The proposed model also outperformed the other pre-trained networks and the state-of-the-art techniques. Thus, the proposed model is ideal for automatic epilepsy seizure detection and can aid neurologists in early diagnosis.

Keywords: Epilepsy, electroencephalography, wavelet transform, deep learning, ensemble network.

1. Introduction

Epilepsy is a chronic neurological disorder characterized by an abnormal increase of neuronal synchronization inside the brain [1]. Globally, it has affected around 50 million individuals of all ages. According to the data provided by the World Health Organization (WHO), it is estimated that around 50 million individuals globally are affected with epilepsy, with over 85% of these cases occurring in low-income countries [2]. The prognosis for the therapeutic efficacy of epilepsy is not promising [3, 4]. Moreover, a significant proportion of individuals in medium and low-income countries, around 90%, are incapable of maintaining regular employment and living normally due to inadequate access to treatment, resulting in substantial financial impacts on their families and society [2].

Diagnosing the onset region of epilepsy is challenging for clinicians due to this condition's recurring and non-stationary character [5]. Due to this reason, the electroencephalogram (EEG) is a commonly

used diagnostic tool for identifying epilepsy. EEG is a non-invasive methodology that offers a high level of temporal resolution. The signals produced via the EEG approach are often called EEG signals or EEG waves. Manually monitoring long-duration EEG signals is a tedious and monotonous task. Therefore, it is necessary to develop an automated epileptic seizure detection system that uses sophisticated signal processing and machine learning techniques to reduce the neurologist's workload by accurately identifying epileptic seizure EEG signals in less time [6]. Hence, developing an automated system for detecting epileptic seizures is now a prominent area of study interest among scholars. With the same line of interest, we present a pre-processed ensembled neural network to diagnose epileptic seizures to eliminate the long-duration monitoring of EEG signals. The main contributions of this paper are as follows:

This paper presents a preprocessing of an epilepsy seizure EEG signal by converting it to scalogram time-frequency representation data using the continuous wavelet transform method.

This study offers an ensemble-based deep classification model using the global average pool technique for accurately diagnosing EEG signals in multiclass-related tasks.

This study presents a comparative analysis of our proposed work against other deep neural networks.

The organization of this work is structured in the following manner: Section II provides an overview of the relevant literature about the classification of epilepsy seizures. In addition, Section III details the materials and methodology used in this work. Section IV presents a concise analysis of performance assessment and experimental outcomes. Finally, section V concludes the paper with a future line of work.

2. Related Work

Over the past few decades, numerous efforts have been made in the academic literature to develop an automated system for detecting epileptic seizures. However, accurately classifying epileptic seizure signals remains a difficult task. Most of the presented methods perform poorly in all relevant scenarios or employ raw EEG signals for feature extraction. Some of them are as follows:

Anuragi et al. [7] decomposed the EEG signals into sub-bands utilizing the empirical wavelet transform using Fourier Bessel series expansion, referred to as FBSE-EWT. Then, these subbands are reconstituted as three-dimensional phase-space representations. Entropy-based characteristics such as norm, log energy, and line length are calculated based on the Euclidean distances of three-dimensional phase-space representations. The features extracted from the above techniques are ranked according to p-values derived from the Kruskal-Wallis statistical test. Finally, the ranked features are ensembled using various classifiers like bagged-k-nearest neighbors, extra tree, bagged-SVM, random forest, and extreme gradient boosting tree for classifying epileptic-seizure EEG signals.

Gupta et al. [8] developed a lightweight convolutional neural network architecture for binary classification of seizure disorder and attained good accuracy in just 20 epochs with minimal trainable parameters.

Kaur et al. [9] proposed a method based on EEG image representations using continuous wavelet transform and transfer learning for epileptic seizure classification. Initially, the Alexnet deep neural network model is fine-tuned on EEG images. The extracted features are given to the support vector machine classifier via a 10-fold image partitioning strategy for epileptic seizure diagnosis.

Rabby et al. [10] presents the hybrid approach of machine learning based on a genetic algorithm and principal component analysis for binary classification of epileptic seizures on an EEG dataset. Furthermore, the performance metrics of this work are compared against the current machine learning method.

Woodbright et al. [11] showcased a novel approach for autonomously extracting features from a convolutional neural network and yielding easily interpretable rules utilized for seizure classification using EEG data. The primary objective of formulating rules or explanations is to elucidate the inherent reasoning behind our methodology, providing the neurologist with a comprehensive understanding of the decision-making process.

A systematic review of the existing epileptic seizure identification literature reveals that most of the machine learning algorithms for seizure detection rely on handcrafted characteristics and sophisticated feature selection procedures. Moreover, the techniques that employ deep convolutional neural networks on raw images lack generalizability on clinical datasets and, in some situations, yield low detection accuracy.

To address these issues, this paper proposes an automated preprocessed ensemble deep neural network (PEDNet) for epileptic seizure diagnosis tool using EEG visual representations that aid medical practitioners in understanding the disease better.

3. Materials and Methodology

This section discusses the dataset and the proposed methodology to detect epilepsy seizures using EEG signal images. The flow of the proposed architecture in detecting seizures using EEG signals is shown in Fig. 1.

3.1 Materials

Dataset: The dataset used to detect seizures using EEG signals is collected from the online dataset of Neurology and Sleep Centre, Hauz Khas, New Delhi [12].

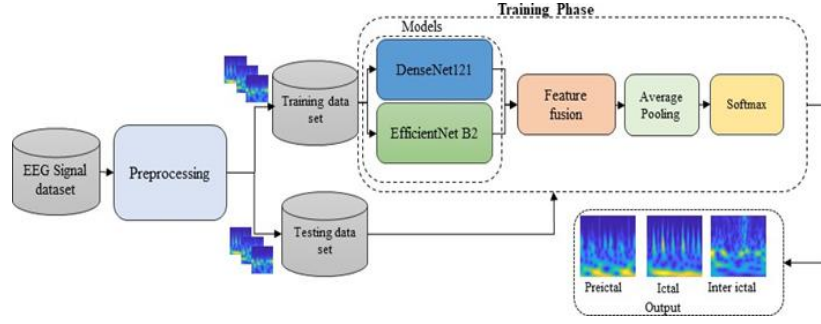


Fig. 1. Work flow of the proposed architecture.

The dataset contains EEG signal recordings of 10 epileptic patients, pre- processed using a bandpass filter with 0.5Hz and 70 Hz as lower and upper cutoff frequencies, respectively. Fig. 2 shows the plot of the 1-D EEG signal of the dataset with 1024 samples. The x-axis represents the number of samples for each EEG signal, and the y-axis represents the amplitude of the EEG signal at each sample.

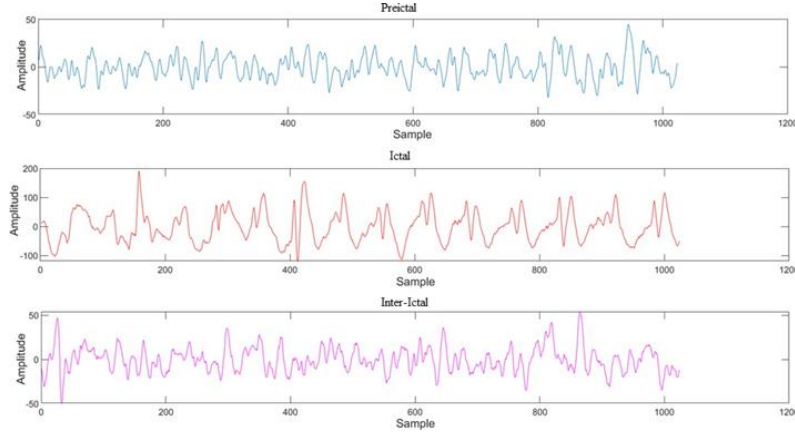


Fig. 2. Plot of Pre-ictal, Ictal and Interictal of EEG signal.

Preprocessing: To detect epilepsy seizures using EEG recordings using the pro- posed methodology, we have produced images with the raw EEG signal. Continuous wavelet transform (CWT) generates the images by varying time and scale values. The cwt equation is shown in eq(1), where τ is translation, s is scale, and $\psi(t)$ is the wavelet function. The scalogram images generated using CWT with amor, morse, and bump wavelets are resized to $512 \times 512 \times 3$. The sample scalogram images are shown in Fig. 3.

$$cwt(\tau, s) = \frac{1}{\sqrt{|s|}} \int_{-\infty}^{+\infty} x(t) \psi\left(\frac{t - \tau}{s}\right) dt \quad (1)$$

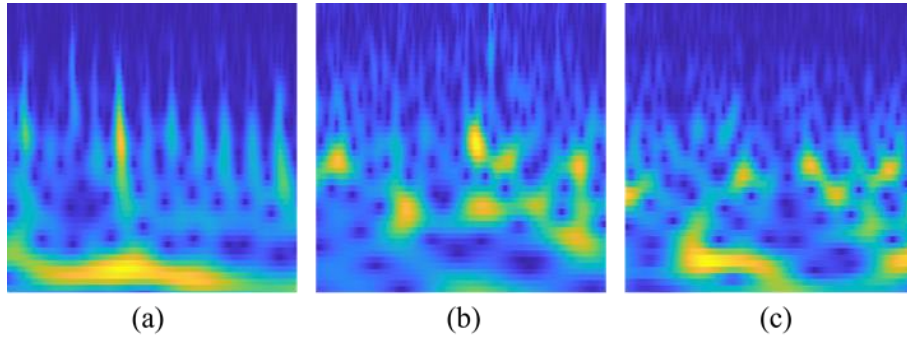


Fig. 3. Time frequency representations of EEG records belonging to each class (a) Pre-ictal (b) Inter-ictal (c) Ictal

3.2 Methodology

The proposed PEDNet model is designed to diagnose epilepsy seizures, as shown in Fig 1. The pre-trained deep-learning (DL) models DenseNet121 and EfficientNet B2 is used to extract the deep features of the scalogram images. The DenseNet121 [13] network uses local, global, and intermediate features within the dense block, which contains six 3×3 and 1×1 layers of each in the initial block, and the number of layers doubles each block with the increase of depth. The feature map extracted from each block uses the deep, dense blocks as local, global, and intermediate features to avoid vanishing gradients and provide better performance. The dense block of the DenseNet121 network is shown in Fig. 4. The number of dense layers used in DenseNet 121 is 3. The high-resolution scalogram images of EEG signal with size $512 \times 512 \times 3$ are used to diagnose seizures. The network which performs better with fewer parameters is EfficientNet-B2. The EfficientNet-B2 [14] model helps scale the network depth, number of channels, and resolution by optimizing for maximum efficiency.

The ensemble model is developed to use the advantage of DenseNet121 and EfficientNet-B2 by avoiding vanishing gradients and improving the performance with high-resolution images in diagnosing seizures using EEG signals. To leverage the features of both networks, features are fused to form a feature fusion vector. The feature fusion vector is followed by average pooling and soft-max layer to diagnose epilepsy seizures.

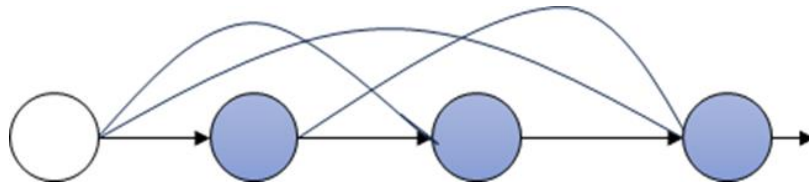


Fig. 4. Dense block of DenseNet121

4. Results and Discussion

This section describes the environment used, performance metrics, and multi- class classification results of the proposed model. Subsequently, the achieved outcomes of the proposed model are compared with other pre-trained networks.

4.1 Environment and implementation

Two environments are used to execute the proposed model. First, MATLAB R2022a is used to execute CWT-based pre-processing tasks. The system configuration used is DESKTOP-8NFE3GM 64-bit operating system, which is run on Windows 10. On the other hand, Google Colab Pro+ is used to train the proposed classification model. The Keras, python, and TensorFlow versions used are 2.13.1, 3.10.12, and 2.13.0, respectively. The GPU is NVIDIA Tesla V100-SXM2 with driver version 525.105.17, 25.46 GB of RAM, and CUDA version 12.0.

4.2 Performance metrics

The performance metrics employed to evaluate the proposed classification model in this paper include accuracy, precision, recall, F1-score, and Receiver Operating Characteristics (ROC) curve.

The total number of patients accurately predicted is referred to as accuracy, as represented in Equation (1).

$$Accuracy = \frac{TPos + TNeg}{TPos + FPos + TNeg + FNeg} \quad (2)$$

Where TPos is the number of patients accurately classified as malignant, benign, or normal. TNeg is the number of accurately anticipated negatives. The FNeg and FPos represent the number of misclassification cases.

Precision is defined as the ratio between TPos and the total number of anticipated positive samples, as shown in Equation (2).

$$Precision = \frac{TPos}{TPos + FPos} \quad (3)$$

Recall demonstrates a model's capacity to predict the positive class accurately when the actual class is positive, as shown in equation (3).

$$Recall = \frac{TPos}{TPos + FNeg} \quad (4)$$

The F1-score represents the harmonic mean of precision and recall, as shown in Equation (4).

$$\frac{2 \times Precision \times Recall}{Precision + Recall} \quad (5)$$

ROC curves display false positive and true positive rates over a threshold range of 0 to 1.

4.3 Experimental setup

The online dataset contains 50 segments belonging to preictal, interictal, and ictal classes, amounting to 150 segments. The different mother wavelets, such as morse, amor, and bump, used to generate scalograms yielded 450 EEG image representations. Subsequently, data augmentation techniques were performed, such as rotation range, width shift range, height shift range, and zoom range equal to 7, 0.05, 0.05, and 0.1, respectively. The top layers of the fused feature model were replaced with a global average pooling layer, a dropout layer of 50%, and three dense layers. Epochs equal to 70, Adam optimizer, 0.00006 learning rate, batch size as 12, and sparse categorical cross-entropy loss function were used. In addition, an early stopping response was utilized to terminate the training if the validation loss of the proposed model did not improve after nine iterations. The best weights of the model were then restored. After constructing and compiling the proposed model, various performance metrics were used to evaluate the performance of the proposed model. Later, it was tested on unseen test data.

4.4 Results

The obtained EEG time-frequency representations are fed to an ensemble model containing EfficientNet B2 and DenseNet 121. Ablation experiments are conducted to leverage features extracted from the pre-trained DL networks. Among the pre-trained DL models are ResNet, DenseNet, and Efficientnet performed better. In this paper, DenseNet121 and EfficientNet-B2 are used to implement the ensemble model for better performance by leveraging the features of both networks in diagnosing seizures using EEG signals. Table 1 shows the performance metrics of the ensemble model. All classes obtained 100% train, test, and Validation (Val) accuracy, precision, recall, and F1-score. The measures used to prevent the model from overfitting is performed through data augmentation techniques.

Table 1. The performance metrics of the ensemble model

Class Train	Accuracy	Val Accuracy	Test Accuracy	Precision	Recall	F-score
Pre-ictal	100	100	100	100	100	100
Ictal	100	100	100	100	100	100
Inter-ictal	100	100	100	100	100	100

Fig. 5(a) shows the confusion matrix of the proposed model. There are no misclassification cases, and the proposed model distinguished each class accurately. Fig. 5(b) shows the ROC curve of the proposed model. Each class obtained a 100% Area Under Curve (AUC) value. Hence, the proposed model is apt for automatic epileptic seizure detection.

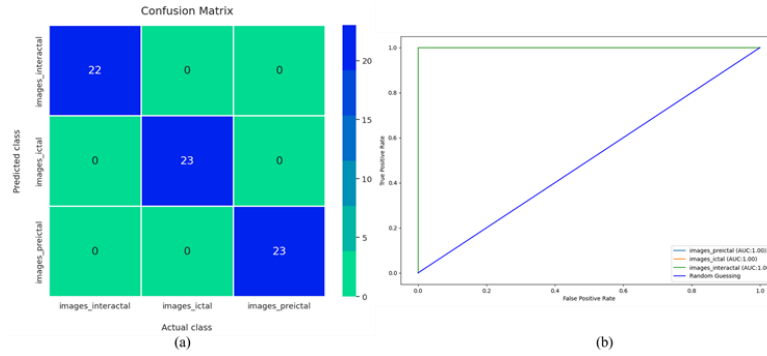


Fig. 5. ROC curve of the proposed model

4.5 Discussion

This subsection compares the proposed model with the other pre-trained networks and state-of-the-art techniques. First, the performance metrics of the proposed model are compared with pre-trained networks such as ResNet50, EfficientNet B2 and Densenet121, as shown in Table 2. The performance of ResNet50 is relatively low. EfficientNet B2 and DenseNet 121 performed better than ResNet 50. However, the proposed model obtained the highest performance metrics of 100%. Hence, the proposed model outperformed the existing models, and thus, it is suitable for automatic epilepsy detection.

Also, the confusion matrix of the proposed model and other pre-trained networks are compared. ResNet50, Efficient Net B2, and DenseNet 121 have three, one, and two misclassification cases, respectively. However, the proposed PED-Net model has zero misclassification cases shown in Fig. 6). Thus, the proposed model is apt for automatically diagnosing epileptic seizures.

Table 2. Comparison of the proposed model with other pre-trained networks

Models	Train Accuracy	Val accuracy	Test accuracy	Precision	Recall	F1-score
ResNet50	97.91	94.12	95.58	95.65	95.83	95.51
EfficientNet B2	100	98.53	97.06	97.1	98.55	97.81
Densenet121	99.48	97.05	95.59	97.1	97.22	97.03

Proposed model	100	100	100	100	100	100
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Next, the proposed PEDNet model is compared with state-of-the-art techniques such as Gupta et al. [8], Rabby et al. [10], Anuragi et al. [7], and Woodbright et al. [11] with respect to accuracy metrics, as shown in Table 3. Gupta et al. [8] obtained the lowest accuracy of 92%. While other methods employed by Rabby et al. [10], Anuragi et al. [7], Woodbright et al. [11] and Kaur et al. [9] performed subsequently better than Gupta et al. [8]. However, the best performance was obtained by the proposed PEDNet model by achieving 100% accuracy and other performance metrics. Hence, the proposed model provided edge-over performance compared to the pre-trained networks and state-of-the-art techniques.

Table 3. Comparison of the proposed model with state-of-the-art techniques

Models	Accuracy	Precision	Recall	F1-score
Gupta et al. [8]	92	-	-	-
Rabby et al. [10]	94	94	90	91.95
Anuragi et al. [7]	98.3	-	-	-
Woodbright et al. [11]	99.67	-	96.29	-
Kaur et al. [9]	98.67	-	100	-
Proposed model	100	100	100	100

5. Conclusion and Future works

Epilepsy is a persistent neurological condition defined by faulty neuronal synchronization inside the brain. Rapid annual development in the number of patients necessitates the need for automated seizure detection methods using EEG data. The proposed model indicated that the pre-processed ensemble deep network outperformed the other pre-trained networks and state-of-the-art techniques in terms of performance. All pre-ictal, inter-ictal, and ictal classes were accurately predicted with no false positives or false negatives cases. The proposed PEDNet model obtained 100% accuracy, recall, precision, F1

score, and AUC value. Thus, the proposed model can aid neurologists in detecting epilepsy seizures. In the future, the number of parameters of the proposed model will be reduced, and subsequently, it will be employed on other epilepsy datasets as well.

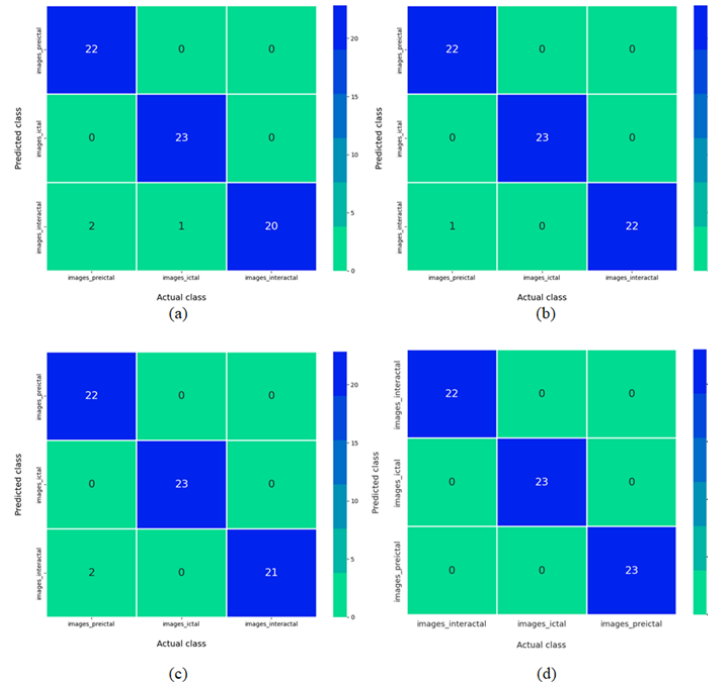


Fig. 6. Confusion matrix (a) ResNet 50 (b) EfficientNet B2 (c) DenseNet121 (d) Proposed model

Acknowledgement

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LJaya Optimization based Feature Selection Approach for ADHD Classification

Samrudhi Mohdiwale¹, Mridu Sahu², G.R Sinha³, Shivangi Diwan²

¹Siksha O Anusandhan University, Bhubaneswar

samrudhimohdiwale@gmail.com

²National Institute of Technology Raipur

³International Institute of Information Technology, Bengaluru

Abstract:

ADHD, categorized by the lack of attention and focus, is one of the most common cognitive disorders. Since EEG signals carry wide-ranging insights about cognition skills, the potential of using EEG signals to detect ADHD has a significant capability. The state-of-the-art methods of detection and treatment of ADHD suffer from the repetitive modules of inattentive targets with a lack of motivational aspect. With the introduction of serious games, engagement and motivation in tasks is no longer an obstacle. Serious games are specially designed for primary purposes rather than entertainment. These games create a unique environment containing interactive and engaging modules specially designed for patient-centric cognitive assessment. FOCUS is one of the serious games designed for ADHD classification. The EEG signal recorded during the FOCUS gameplay shows ADHD patients have lower attention and different EEG band activity was observed in ADHD patients than Non-ADHD subjects. In this work, we have analyzed different EEG Frequencies along with some derivative frequencies that can be useful to categorize ADHD and Non-ADHD Patients. The dataset includes eight subjects having ten sessions for each subject. For each session of recording, nine different frequency-based features are extracted. Further, to identify the relevant features which are having higher impact on classification, feature selection technique has been used. In this work, we have proposed a Logical Jaya Optimization based feature selection method for classification of ADHD Patients. The objective function is designed to maximize classification accuracy. The study uses the wrapper method of feature selection and classification accuracy used as the objective function which needs to be maximized. Significant improvement in the accuracy has been achieved by applying the Logical Jaya Optimization algorithm. The results show that, by applying the LJaya feature selection, we have achieved classification accuracy 99.46%. The study also gives a set of relevant features that helps to improve the accuracy of classifiers. The results obtained from the study are also compared with existing work on the dataset.

Comparison with existing work also shows the better performance of wrapper method-based LJaya algorithm of feature selection for classification of ADHD Patients.

Keywords: ADHD Classification · Jaya Optimization · Feature Selection · Machine Learning

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a widespread and commonly occurring brain development disorder. This has gained huge attention from the medical and research communities around the world because of its profound impact on affected individuals[1]. This condition is characterized by inattention, impulsiveness, and hyperactivity and affects a considerable percentage of the global population, children and kids at large. This presents challenges not only in terms of individual well-being but also poses broader societal and economic implications[2]. Earlier the diagnosis of ADHD was majorly based on behavioral observations and clinical evaluations. ADHD has traditionally been diagnosed through behavioral and clinical observations. However, the subjectivity of these methods and varying sensitivity highlight the need for more objective, reliable, and scalable diagnostic tools[3]. Neuroimaging, particularly EEG signal processing, has shown immense potential for ADHD diagnosis. The magnitude and complexity of EEG data, on the other hand, provide a number of significant challenges. Because of the enormous dimensionality of these datasets, effective feature selection procedures are required in order to isolate significant patterns and get rid of information that is superfluous[4–6]. Effective feature selection not only improves the accuracy and efficiency of diagnostic algorithms, but it also offers clearer insights into the underlying neural signatures of ADHD[7, 8]. A new frontier has opened up as a result of the rapid developments that have been made in optimization strategies; this new frontier takes the form of algorithms that are bio-inspired. An innovative solution to optimization problems can be found in the form of the LJaya optimization algorithm and Teaching Learning based Optimization (TLBO), which was conceptualized after the natural display phenomena. If the power of these algorithms could be harnessed for feature selection in EEG data analysis, it could be possible to make significant strides in the field of ADHD classification. Through the course of this research project, we present and analyze a LJaya Optimization-based Feature Selection Approach and Teaching Learning based Optimization (TLBO) [9, 10] that has been modified specifically for ADHD classification utilizing EEG data. In order to extract relevant features from EEG datasets, our method aims to make use of the efficacy and adaptability of the optimization algorithm. This paper is structured as follows: The subsequent sections delve into the literature review methodology, detailing the nuances of the proposed model, specifically LJaya optimization algorithm. This is followed by a comprehensive discussion of our experimental results and the key findings. The

concluding section encapsulates the contributions of the study and outlines potential avenues for future research.

2. Literature review

The electroencephalogram (EEG) studies in cognitive science have shed light on the intricate patterns of the brain and their correlative behaviors. Researchers have probed the EEG's potential as a tool for diagnosing ADHD because it contains a wealth of information about cognitive skills. Initial research shows that people with ADHD often show unique EEG patterns, especially during attention-related activities. Ghaderyan, Peyvand, et al. presented a new EEG feature called Dynamic Frequency Warping (DFW), which is generated from the dynamic evaluation of frequency variations. The study also spearheaded the development of a novel EEG classification methodology utilizing sparse coding, which has been specifically customized to identify Attention Deficit Hyperactivity Disorder (ADHD) with 99.17% accuracy. ADHD is a common brain condition in children, often treated with medical and educational help[11]. Lim, Choon Guan, et al. developed a brain-computer interface (BCI)-based attention training program, a tablet version of the training program that can be seamlessly integrated with wireless EEG headsets[12]. Chugh, N. et al. introduced a hybrid deep learning model that integrates long short-term memory (LSTM) with CNN. EEG data's spatial properties and long-term interdependence are captured by this hybrid model and evaluated on two available EEG datasets. The classification accuracy of 98.86% on ADHD and 98.28% on FOCUS was captured and thus aids in ADHD diagnosis[13]. Pandria, Niki, et al. conducted a pilot study for the ADHD360 platform with participants aged 7 to 16, including both ADHD and non-ADHD individuals. The study consisted of two main phases: initial neuropsychological evaluation using the mobile app and a serious game i.e., interaction with the "Pizza on Time" game'. Machine learning algorithms (NB, SGD, SVM, KNN, LR, RF, Ridge classifier, and Passive aggressive classifier) were used to recognize ADHD and non-ADHD gameplay patterns and assess ADHD likelihood. SVM earned the highest F1 score[14]. Alchalabi, Alaa Eddin, et al. showed the amalgamation of an EEG-monitored serious game designed to enhance patients' attention capacity, alongside the utilization of machine learning to determine their attention span. The comprehensive studies involving ADHD patients demonstrated an accuracy rate nearing 98%, accompanied by a standard uncertainty of 0.16%, in the identification of ADHD cases[15]. Machado, Fabiana SV, et al. presented neurofeedback(NFB) training that uses serious games to engage participants. This research created a meaningful game for ADHD kids' neurorehabilitation[16]. Delisle-Rodriguez, Denis, et al. developed an EEG-based BCI for attention training that records neural data from specific brain areas and translates it into game control signals to modulate theta and beta rhythms. The BCI design uses the classifier's output and a cubic regression model to provide visual feedback that matches the user's attention level and theta/modulation[17].

Ganiti-Roumeliotou, Efstratia, et al. introduced “ MindOfMine,” a brain-based instructional Serious Game for mental illness cognitive deficits. MindOfMine’s usability was assessed using the System Usability Scale, and patient comments were collected using a modified Attitude Towards Computers Questionnaire. The game’s impact on neurocognitive functions was tested using the Wechsler Adult Intelligence Scale and STROOP[18].

3. Methodology

This section describes the method used for classification of ADHD patient among the normal patients. The flowchart is presented below in Fig. 1. The EEG signal recorded during the gameplay are preprocessed, and filtering techniques are applied to obtain the frequencies, namely alpha, low beta, high beta, gamma, and theta. Secondary features, theta/low beta, theta/high beta, alpha/low beta, and alpha/high beta, are added. These secondary features relate to the person’s attention levels as presented in different studies of ADHD classification. The nine features are provided by [15] to carry out further research.

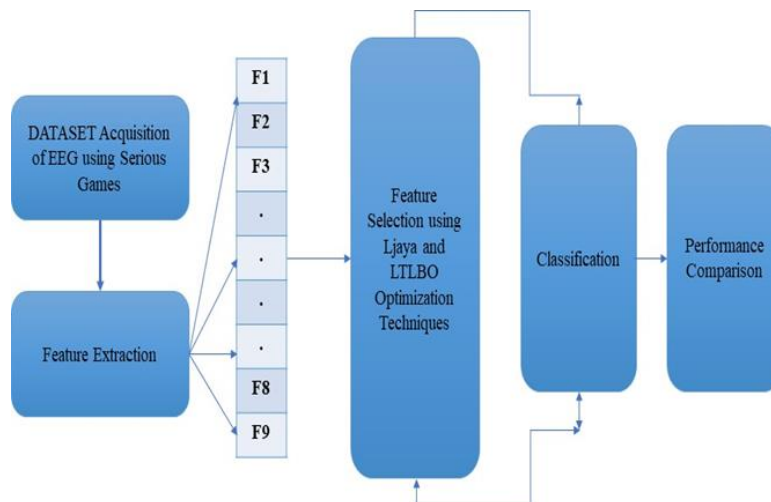


Fig. 1. Flowchart of Methodology

3.1 Dataset Description

In this work, the dataset is obtained from [15]. The EEG signal was recorded in a controlled environment during gameplay by eight different subjects during gameplay. EMOTIV EPOC+ kit is used to record EEG during the play. The game challenges the player to move an avatar by focusing and using mental commands, to collect all the cubical pickups in the shortest time possible. A brief description of the dataset is presented in Table 1.

Table 1. ADHD Dataset Description

No. of Subjects	8
Average Age	18-26
Modality during EEG Acquisition Focus Game Play	
Duration of Test	2.5 Mins
Number of Session	10
Number of features	9
Number of Classes	2
Classification	ADHD vs Non-ADHD

3.2 Proposed Methodology

Features play an important role in categorization of ADHD. From the dataset, it has been observed that frequency based analysis is having an important role for the classification. Selection of relevant set of frequency based features can improve the performance of classification. Keeping this goal in mind, new algorithm specific parameter free optimization techniques has been used in this work. The original methods of Jaya optimization algorithms and Teaching Learning based Optimization (TLBO) has been proposed by [19, 20]. These methods are designed for continuous optimization problems. In this work, the task of feature selection is a binary optimization problem hence, the methods are modified using logical operators. These algorithms select the relevant features and provide the subset of features that enables improved performance at the time of classification of ADHD patients. The objective function is designed such that it maximizes the classification accuracy. The objective function is the function of features.

$$\text{ObjectiveFunction} = \text{Maximize}[\text{Accuracy}(F_k)] \quad (1)$$

Where F represents the Features and k represents the number of features. Here the classification model is selected as a decision tree since it provides the maximum classification accuracy. The update equations of LJAYA are modified as [21]

$$B_{i+1,j,k} = (B_{i,j,k} \oplus B_{best}) \oplus (B_{worst} \odot B_{i,j,k}) \quad (2)$$

where, $B_{i+1,j,k}$ corresponds to new solution for i^{th} iteration; B_{best} is the best solution; B_{worst} till i^{th} iteration, $B_{i,j,k}$ is the current solution and r_1, r_2 are random numbers.

Logical TLBO also modified to solve the problem of feature selection as presented in [22]. The flowchart of LJAYA is presented in Fig. 2. The results obtained using the approach are presented in the next section.

4. Experimental Results and Discussion

This section presents the results obtained from feature selection using the proposed algorithm along with the classification accuracies. To classify the ADHD

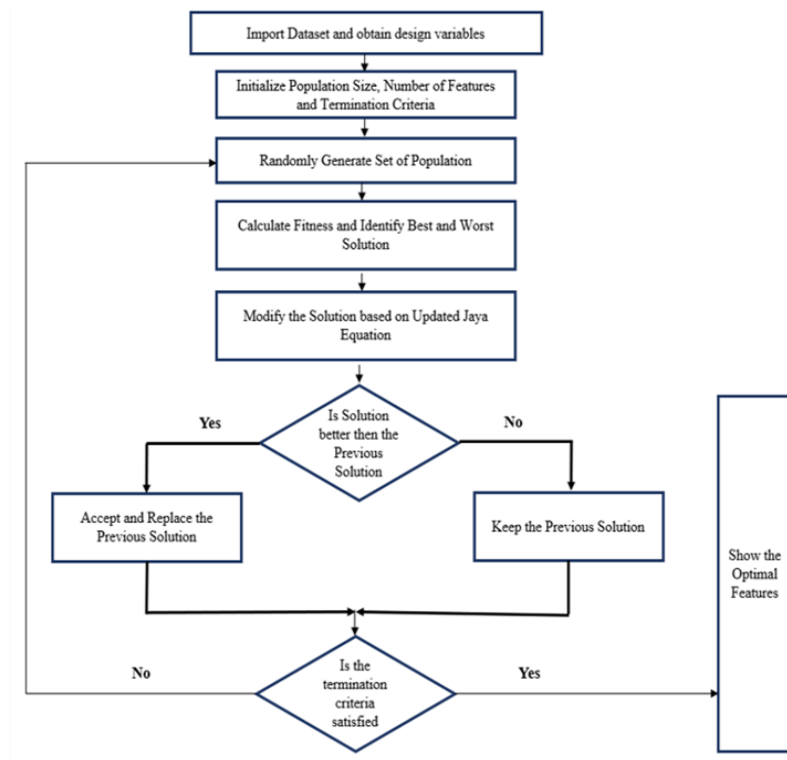


Fig. 2. Flowchart for LJAYA Optimization for feature selection

vs. Non-ADHD patients, the proposed model is evaluated in terms of classification accuracy, convergence, and comparative analysis with the existing technique. The results are presented in Table 2 and Figure 3.

The results presented in Table 2 show that the proposed algorithm of LJaya and LTLBO outperforms the other existing ML algorithms regarding classification accuracy. The maximum accuracy of 99.46% is achieved. The convergence curve is also presented in Figure 3. The figure shows that both the proposed methods don't stick into local minima and achieve convergence in less than 15 iterations.

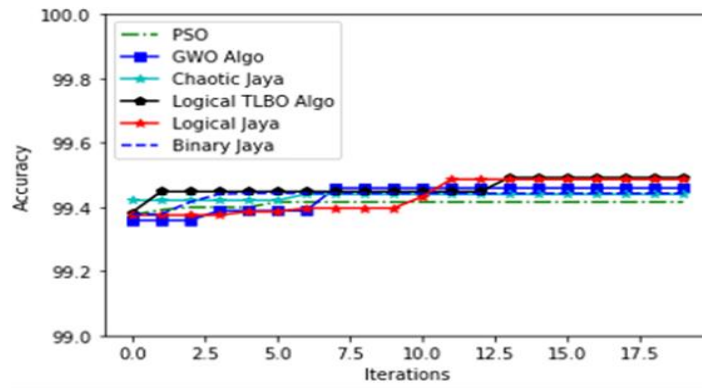


Fig. 3. Convergence Curve for Feature Selection on ADHD Classification

Table 2. Results and Comparative Analysis of Proposed and Existing Model

Data Used	Methods	Accuracy (%)
Focus EEG Dataset	Proposed LJaya Optimization	99.46
Focus EEG Dataset	Proposed LTLBO Optimization	99.40
Focus EEG Dataset [15]	SVM	98.62
Focus EEG Dataset Weighted	KNN	98.4
EEG with EYE Closed [23]	RBF Neural Network	95.6
EEG During Cognitive Task [24]	RBF – SVM	95.4
ADHD vs ASD Behavioral Data [25]	SVM-/LDA/ Categorical -LASSO	96.2
MRI [26]	RBF SVM	86.55

4. Conclusion

This study introduced the LJaya and LTLBO feature selection techniques for EEG signals from ADHD and non-ADHD participants during focused game-play. Our findings indicate that the proposed methodologies are effective while performing classification between the two groups. By utilizing the LJaya and LTLBO methods, we were able to effectively reduce the dataset's high dimensionality and remove irrelevant features. This modification substantially improved the classification accuracy of ADHD, a cognitive disorder. In conclusion, our findings indicate that the LJaya and LTLBO methods considerably improve the overall efficiency of classifying subjects based on their EEG signals during game-play. In the future, our objective is to enhance and optimize these methodologies by integrating a wider range of datasets and investigating their suitability in real-time diagnostic situations.

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EEG Based Mental Workload Classification Using End To End Riemannian Geometry and Restricted Boltzmann Machine based Data Fusion

Swapnil Singh¹, Vartika Gupta¹, and Tharun Kumar Reddy²

¹ Indian Institute of Technology Kanpur, Uttar Pradesh, 208016, India

² Indian Institute of Technology Roorkee, Uttarakhand, 247667, India

{tharun.reddy@ece.iitr.ac.in},swapsing, vartikag,@iitk.ac.in}

Abstract

Human working efficiency and precision is entirely dependent on human mental capacity which is largely affected by workload scenarios. Cognitive workload estimated on Brain-Computer Interfaces (BCI) has become a crucial indicator of mental busyness in recent times. It has implications for interactions between Computers and Humans. In this research, we deal with the problem of the Within-Session variability of brain signals like ElectroEncephaloGraphy(EEG), which is one of the significant challenges faced during implementing cognitive state decoding in daily life using passive BCIs. Riemannian methods are the state-of-the-art methods in EEG BCI. We use Riemannian Geometry approaches with several adaptations to tackle the mental workload categorization problem for a single participant (intra-subject estimation) while training on EEG data from another session (inter-session adaptation). We saw a 15% improvement in performance above the baseline technique, thereby answering the research challenge.

Keywords: EEG · Brain Computer Interface · Riemannian Geometry

1. Introduction

Brain-Computer Interfaces or BCIs allow users to adjust neural signals, such as the electroencephalogram (EEG), to control an application or an external device. EEG-based BCIs are being used and deployed extensively to solve various real-life problems due to associated advantages. Portability, cheap cost, and great temporal resolution are just a few of the benefits. Passive Brain-Computer Interfaces (BCIs) use brain signals to evaluate users states, such as cognitive or affective states, and then interact with the human-computer system accordingly. Therefore, passive BCIs have been used for a variety of purposes, including mental workload estimation of users trying to adapt educational materials; preventing aeroplane pilots from becoming overloaded and missing alarms;

estimating users affective states and designing adaptive video games that maximize user excitement and pleasure accordingly, and so on.

The term "mental workload" refers to how busy a person's mind is when completing a specific action. It can be defined as the cognitive allocation of attention per the mental requirements of the mental task at hand [1]. Primary task performance measure, secondary task performance measure, physiological measure, and subjective-rating measure were the four principal methodologies utilized to quantify mental workload [2]. Traditionally, subjective rating measurement was used to evaluate mental workload for tasks such as Modified Cooper-Harper Ratings (MCH), NASA Task load index (NASA-TLX), and Subjective Workload Assessment Technique (SWAT), among others, where evaluation was based on the subjects' judgement and personal experience [3]. With passage of time, there is a shift observed from subjective-rating measurement to physiological measurements such as heart rate, brain activity, and eye movement measurement for predicting mental workload [4] [5] [6].

The effectiveness of human cognitive capacities can be better understood by evaluating physiological changes by measuring brain activity for mental workload classification. BCI can estimate cerebral activity (workload) based on the user's brain signals [7]. About 10 billion neurons make up the human cerebral cortex, which is separated into specific regions to carry out various movement, cognition, and sensation-related tasks. The human cerebral cortex is made up of Frontal, Parietal, Temporal and Occipital lobes. Mental Workload changes activities of alpha, beta, theta and delta bands of EEG in these cerebral regions. It is seen that the EEG theta power at frontal electrodes and alpha power at the parietal electrodes is powerful and distinguishable as compared from the other EEG components [8] [9]. Thus, in our approach we majorly work with EEG data collected from Frontal and Parietal Regions. As brain waves are non-stationary, we must deal with a lot of real-time problems in order to process them. As a result, there is an increasing demand for a reliable workload classification method that can provide more information about the workload.

In comparison to fNIRS, ECoG, and MRI, EEG offers an excellent spatiotemporal resolution, is straightforward to operate, and is a cost-effective non-invasive technology. Also, the former technologies are expensive and have a complicated architecture, while not being useful in real-time as an EEG. This encourages us to use EEG data to accurately estimate Mental Workload (MW). Experimental techniques for estimating MW include (MATB -2) tasks which are the second set of tasks in the Multi Attribute Task Battery. NASA created MATB tasks in order to measure MW. We emphasise on passive BCI (pBCI), where brain signals are motivated by mental workload activities, as opposed to active BCI (aBCI), when the user consciously generates brain signals [10]. Even with EEG, as the number of electrodes utilised increases in order to achieve better spatio-temporal resolution, there remains a severe issue of electrode interference [11].

For EEG signal processing and mental workload classification for MATB tasks, classifiers such as Support Vector Machine (SVM), Artificial Neural Network (ANN) [12], Bayes model [13], and Linear Discriminant Analysis (LDA) are employed in conjunction with Power spectrum density [14]. For EEG classification, state-of-the-art algorithms such as Machine Learning [15, 16], Transfer Learning [17] and Riemannian Geometry [18] are in use. However, these algorithms have not been adapted sufficiently to classify mental states.

In this paper, we propose employing Transfer Learning and Riemannian Geometry-based approaches [19] to tackle mental workload classification for a specific subject. These methods make use of cross-session EEG data from the Neuroergonomics Conference Grand challenges Hackathon 2021's cognitive thinking task classification.

Our proposed contribution is a unique end-to-end Riemannian Geometry pipeline adaption along with RBM [20] [21] based feature fusion for cognitive state classification that has greatly enhanced state-of-the-art performance and won the challenge in 2021. The remainder of the paper is laid out as follows: The Dataset is described in Section II. The proposed classification methods are given in Section III. The proposed architecture is assessed with the EEG dataset and the results are reported along with implementation details in Section IV. Sections V and VI bring the paper to a close.

2. Dataset

Our approaches are tested using the Passive BCI NeuroErgonomics Conference (NEC) Hackathon public workload estimation dataset [22]. The data was collected for 15 volunteers (6 females, 9 average age of 25) throughout three separate experimental sessions separated by one week. A brief warm-up/training period preceded each session. After that, a resting condition was recorded for one minute with the eyes open. The participants next completed a MATB-II task that consisted of three 5-minute blocks, each with a different level of difficulty (i.e. different workload level) presented pseudo-randomly. Three levels of workload were elicited by increasing the number and difficulty of the sub-tasks. A 64-active Ag-AgCl Electrode setup was used to collect the data. Only 62 electrodes were used in the end since one electrode was rendered useless and another was dedicated to recording heart activity. They were arranged in a 10-20 system, which is used over the world. 500Hz was used as the sample frequency. Efforts were made to keep impedance below 10k as much as possible. The organisers also preprocessed the raw data and made it available in the competition.

2.1 MATB-II Task Description

The Multi-Attribute Task Battery-II (MATB-II) was created by NASA to test task-switching and mental workload capacity. The subjects must complete many sub-tasks at the same time. The tasks vary in difficulty based on the condition, difficulty, and the number of sub-tasks.

Easy condition (label 0): The participant is required to complete the TRACK and SYSTEM MONITORING task. TRACK is a manual control simulation in which the participant must maintain a target in the middle of a window. The SYSTEM MONITORING TASK necessitates the constant monitoring of two warning lights and four gauges.

Medium condition (label 1): With the two tasks in the Easy Condition, RE- SOURCE MANAGEMENT is introduced as the third task. It depicts a fuel management system in which the subject maintains a specified gasoline level by turning on and off a series of pumps that distribute fuel to various reservoirs.

Difficult condition (label 2): The COMMUNICATION job is added to the list of three preceding tasks. Now the subject must reply to radio communications by switching between different radio frequencies. Also, in this challenging situation, the TRACK duty becomes more difficult.

Each condition lasted a total of 5 minutes. The order of the tasks was run- domised, so participants did not necessarily start with the easiest task first. In addition, participants may have completed other tasks in the intervals between conditions.

3. Proposed Method

The proposed work primarily proceeds through end-to-end Riemannian Geometry- based preprocessing, feature extraction, and classification. To estimate a person's workload, covariance features and Tangent Space features extracted from the pre- processing stage are fed to Minimum Distance to Mean (MDM), Deep Neural Network (DNN), and Support Vector Machine (SVM) classifiers. The classifi- cation accuracy of these models on held out validation data is shown in Table 1. The SOTA baseline model incorporates SPD characteristics into the SVM model. The results can be compared to those of other models that include Riem- manian Geometry (RG) features. The final proposed method uses a Restricted Boltzman Machine to fuse the different channels of EEG features and gives a considerable improvement in performance as can be seen in Table I.

3.1 Pre-Processing

The raw data is first filtered using a 5th order Butterworth Filter inside the alpha (8 - 13 Hz) and theta (4 - 7 Hz) frequency ranges. We further slice out the data corresponding to 9 frontal electrodes (F7, F5, F3, F1, Fz, F2, F4, F6, F8) and 9 parietal electrodes (P7, P5, P3, P1, Pz, P2, P4, P6, P8) and continue to work with the new sliced data.

Further, to reduce the space and time complexity of models without sacri- ficing data variability, we used Riemannian distance-based electrode selection, a subject-specific channel selection method [18]. The pairwise Riemannian dis- tance between covariance matrices is obtained in this method for each k^{th} class ($k = 0, 1, 2$). The Riemannian distance between two covariance matrices C_1 and C_2 can be calculated using the following formula:

$$\delta_r(C_1, C_2) = \|\text{Log}(C_1^{-1}C_2)\|_F \quad (1)$$

where $\text{Log}(\cdot)$ is the log-matrix operator and $\|\cdot\|_F$ is the Frobenius norm of a matrix.

A subset of 9 channels is selected separately for the frontal and parietal electrodes and pruned progressively to maximise the average Riemannian distance obtained between all pairwise class-conditional matrices as illustrated earlier. The pairwise Riemannian Distance is δ_R , and $K = 3$ is the number of classes.

$$\sum_{k=0}^{K-1} \sum_{j>k}^K (\delta_R(C_k, C_j)) \quad (2)$$

The selection measure based on the validation accuracy of fine-tuned models is used to evaluate the most relevant subject-specific channels. It also takes into account the diversity and variability of data among the many subjects. Each subject's channel number is lowered from 61 to 12 channels (6 Frontal and 6 Parietal channels).

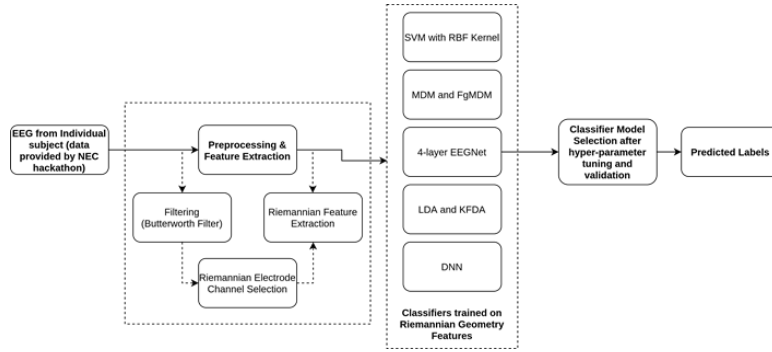


Fig. 1. Mental Workload prediction Machine Learning pipeline

3.2 Feature Extraction using Riemannian Geometry

For feature extraction, Riemannian Geometry methods were applied to the covariance matrices. The covariance matrix C , corresponding to each trial $X \in \mathbb{R}^{n_c \times n_s}$ (where the number of channels and number of temporal samples is represented by n_c and n_s respectively) is calculated using the Ledoit-Wolf covariance estimator [23] as below:

$$C = (1 - \alpha)A + \alpha \frac{\text{trace}(A)}{n_c} I \quad (3)$$

where the shrinkage factor, $\alpha \in [0, 1]$ is estimated using Ledoit and Wolf function, I is a $n_c \times n_c$ identity matrix and A is the simple covariance matrix which is calculated as:

$$A = \frac{XX^T}{\text{trace}(XX^T)} \quad (4)$$

The covariance matrix space is a Riemannian manifold that can be differentiated. The derivatives at a point on the manifold, where a matrix C is in a vector space, and used to calculate the tangent space. Due to the ease of mapping each covariance matrix C_i into the tangent space classification methods based on projections into hyperplanes like SVM, LDA, and Neural Networks are efficient on Tangent Space. Mapping each C_i into the tangent space gives us a corresponding s_i yielding a set of vector features.

$$s_i = \text{upper}(C_\theta^{-\frac{1}{2}} \text{Log}_\theta(C_i) C_\theta^{-\frac{1}{2}}) \quad (5)$$

where $C_\theta = \theta(C_i, i = 1 \dots K)$ and θ is the Riemannian Mean of covariance matrices calculated as:

$$\theta(C_1, \dots, C_K) = \arg \min_{P \in P(n)} \sum_{i=1}^K \delta_r^2(C, C_i) \quad (6)$$

As a result, we used the linearization of the manifold of the RG covariance matrix to calculate tangent space features, as explained above. Before providing the final train and test data to the classification models, we shuffle it. Features for baseline methods are extracted from concatenated data of frontal and parietal channels. whereas, proposed novel approach consists of extracting features separately for the parietal and frontal channels with Riemannian channel selection and then fusing them together using Restricted Boltzmann Machine.

3.3 Baseline Models

Support Vector Machine Classifier on Tangent Space Features (RG + SVM) Support Vector Machine (SVM) categorization uses decision hyperplanes to determine decision boundaries in input space or high-dimensional feature space. From a set of labelled training datasets, SVM creates a hyperplane. The samples were divided into classes using this hyperplane. The maximum distance between the hyperplane's closest negative and positive samples determines the linear separator in most cases.

The extracted characteristics are represented as points on the Tangent Space, and the similarity or proximity of the points is computed using the RBF kernel function, which is mathematically described as:

$$K(X_1, X_2) = \exp\left(-\frac{\|X_1 - X_2\|^2}{2\sigma^2}\right) \quad (7)$$

Where $\|X_1 - X_2\|^2$ is the Euclidean Distance between two points X_1 and X_2 and σ is our hyper-parameter.

Minimum Distance to Mean Classifier on Covariance Features (RG + MDM) According to the Riemannian Distance $\delta_r(C_1, C_2)$ determined earlier, the MDM classifier provides a label to the test covariance matrix C_i of the incoming trial 'i' corresponding to the closest class prototype in $C_1, C_2, \dots, C_K$ for a K class classification problem.

Deep Neural Network Classifier on Covariance Features (RG + DNN) The Neural Network Classifier is provided with the spatial covariance matrix as a feature vector. These attributes are used by the Classifier's embedded non-linearities to create a non-linear decision boundary.

3.4 Data Fusion using Restricted Boltzmann Machine

Restricted Boltzmann Machines are stochastic neural networks that belong to a category of energy based models that identifies inherent patterns in the data by reconstructing inputs. Each RBM consists of visible and hidden units. RBM is trained using Gibbs Sampling and Contrastive Divergence. The main purpose of the RBM is to learn a better representation of a feature set in a compressed form. Fig. 4 shows an example of an RBM. For a given input vector $x = \{x_1, x_2, \dots, x_6\}$, the RBM tries to learn a function such that the network output $h(x)$ approximates the input vector x . The hidden representation of x is given by $\hat{h}(x)$

$$\hat{h}(x) = f(a(x))$$

where $f(\cdot)$ is usually a sigmoid function and $a(x)$ is a linear combination of input features along with the associated weights. In the proposed approach, we fuse the frontal channel and parietal channel EEG features using a RBM as both of them belong to different spatial regions. The represented features of the first layer are concatenated and given as input to the hidden layer of the second RBM. The final represented features of the second layer (output of the hidden nodes at second layer) are considered as the fused features. Fig. 2 is a pictorial illustration of the proposed data fusion technique.

4. Results and Implementation Details

For the baseline classification, Minimum Distance to Mean (MDM) and Deep Neural Network (DNN) classification methods take the Spatial covariance matrix as a feature C of the selected channels (Frontal and Parietal) as calculated in (2). Whereas tangent space features of the selected frontal and parietal

regions as calculated in (5), are used as input to the Support Vector Machine (SVM) classification methods (see fig. 1). We implemented the SVM model with a radial basis function kernel along with subject-specific regularisation parameter(R). Specific regularisation parameters were obtained by fine-tuning the model for each subject separately to a range of (0.1, 10). In addition to the following we employed the MDM model on the Riemannian metric to classify by the shortest Riemannian distance between the test covariance matrix and intra-class covariance matrix means. We also implemented a 5-layer fully connected sequential classification DNN model with Adagrad optimizer, categorical crossentropy loss function and a learning rate of 0.00045 , which iterated for 200 epochs. (512, relu), (256, tanh), (128, tanh), (64, tanh) and (3, softmax) are the corresponding layers. We implemented a baseline model employing EEG theta oscillatory activity (4-8 Hz) features (SPD Features) [14] with an SVM classifier for comparison. We can notice from Figure 2 that the Riemannian Geometry-based end-to-end approach (i.e. Riemannian preprocessing and Riemannian Feature Extraction with DNN classification) performed the best over other applied techniques, improving the state of the art performance by 15%. Also, paired t-test revealed statistically significant performance improvement (P -value < 0.01) for the proposed models over the baseline SPD method. Riemannian Features effectively capture the features specific to the information space in which EEG signal space is embedded, in fact on a manifold.

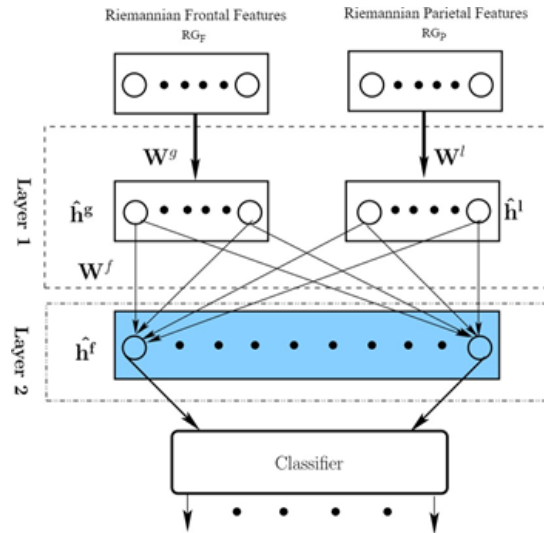


Fig. 2. Feature Fusion with RBM

Table 1. Average Accuracy for each Method

Method	Average Accuracy
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SPD Features + SVM (Baseline)	0.5009395
RG Features + MDM	0.6010826
RG Features + SVM	0.6224492
RG Features + DNN	0.6550038
RBM Fused RG Features + XGBoost	0.7570425

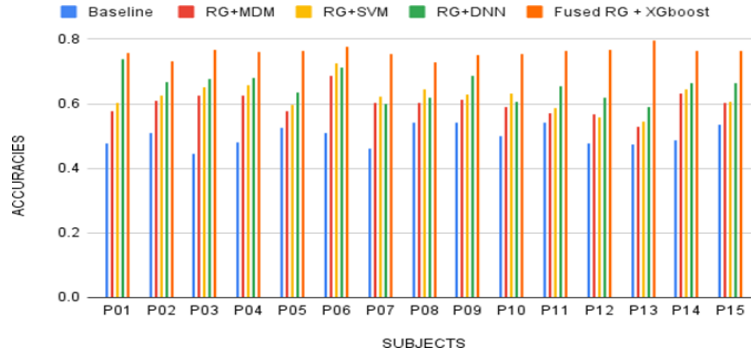


Fig. 3. Plot for Subject-Wise Method-Specific Average Accuracy

4.1 XGBoost Classifier on Fused RG Features

XGBoost Classifier on fused RG features (Fused-RGXGB) Since, RG feature classification gives comparable results with the highly robust EEGNet model [24], we experimented with fused RG features as a unique approach. The Riemannian features RGF and RGP are calculated using the scalp frontal EEG XF and parietal EEG XP and passed into the RBM for fusion. The fused RG features obtained are then used for oscillatory activity classification using XGBoost classifier. The accuracy of 0.75 as seen in Table I is a good performance for a multi-class classification problem. Also, paired t-test revealed statistically significant performance improvement (P -value < 0.01) for the proposed model (Bolded in table I) over the baseline models (unbolded models in Table I).

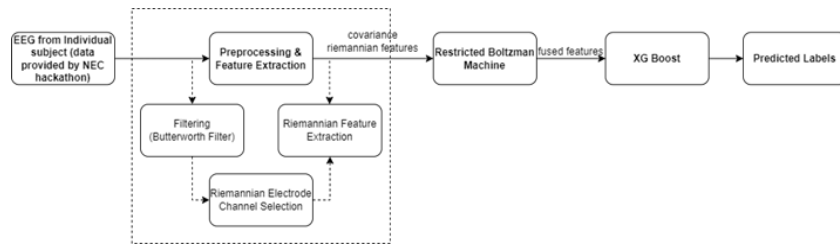


Fig. 4. Proposed Method - Fused RG features using RBM and classified using XGBoost

We can see the subject-specific accuracies achieved by various models in Fig3. Fused RG with XGBoost outperforms other models for all the subjects. The accuracies achieved by other models can be further increased to be comparable with Fused RG with XGBoost results by performing transfer learning on the models, which is also a future prospect.

5. Conclusion

We present a new end-to-end Riemannian Geometry-based paradigm for EEG- based Cognitive Mental State Classification in this paper. The topic of cross- session adaptability is specifically addressed. On average, we found that using Riemannian Geometry preprocessing and Feature Fusion in combination with a Deep Neural Network (RBM) enhanced performance by over 15%.

6. Future Work

In the future, we will focus on inter-session adaptability for the EEGNet model utilising adaptive Riemannian methods and transfer learning methods to counter the performance loss caused by data drifts between sessions. Further possible improvements in EEG signal processing can be done by advanced filtering and improving the signal to noise ratio (SNR).

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Oral Papers/ Abstracts

Effect of Rajayoga based resilience program on resilience among college students-pilot study

Ramajayam Govindaraj¹, Susmita Halder², Susheel Chandra³

¹Centre for Consciousness Studies, Department of Neurophysiology, NIMHANS, Bengaluru

²Amity University, Kolkata

³Institute of Nuclear Medicine & Allied Sciences(INMAS), DRDO, New Delhi

Abstract:

College going youth population experience tremendous amounts of stress due to constant demand for excellent performance and high competition in the job market. Resilience being a protective factor, could enhance positive mental health and reduce occurrence of mental illness among the young population. However, the impact of resilience building programs is least studied among college students. In this study, we examined the effect of rajayoga based resilience programs on resilience of college going youth. In a single group pre-post design, 20 university students were given an online rajayoga based resilience program over a period of 8 weeks, 3-4 sessions (45 minutes session) per week. Resilience was assessed before and after intervention using Connor Davidson Resilience Scale or CD-RISC-10. Six of the 20 recruited students dropped in the first week. Remaining 14 students completed the intervention for 8 weeks including the pre-post assessment. There were 9 females & 5 males with an average age of 20yrs. Mean resilience score of 14 participants assessed by CD-RISC 10 increased from 24.4(8.14) to 29.4(7.63) following intervention (Refer Figure 1). Mean scores were compared with paired t test allowing a type I error of 5%. The increase in mean post resilience scores was statistically significant($p=0.03$) with a Cohen's d effect size of 0.6. Rajayoga based resilience intervention program enhances resilience in college students. However large scale randomized controlled trials are required for bringing policy level change at the university curriculum to incorporate resilience programs for students.

Measuring the Human Nasal Dominance in Context of Svara Yoga: A Low-Cost Tool Based on Nasal Airflow Detection

Satyam Tiwari ¹Jatin Makhijani ² Dhwani Soni ³ Dr. Arnav Bhavsar ⁴

¹ IKSMHA Centre, IIT Mandi, Himachal Pradesh, India

² S CVMU Charotar Vidhya Mandal University, Gujrat, India

D22116@students.iitmandi.ac.in

Abstract:

Human nasal dominance, characterized by variations in airflow or pressure between the nostrils due to transient obstructions caused by erectile tissue, has significant implications for wellbeing, as it is related to neurological and physiological aspects [1]. In Svara Yoga, which is one of the authentic and ancient traditions of Yoga, the concept of human nasal dominance holds great importance, the alternating airflow or pressure variations between the nostrils correspond to the activation of specific energy channels or "Nāḍīs" in the subtle body [2]. The transient obstructions caused by erectile tissue in the nostrils are linked to the flow of Prāṇa (life force energy) and can be influenced through specific techniques in Svara Yoga and Haṭha Yoga [3]. Accurate detection of nasal airflow and dominance is essential for understanding Svara Yoga, the dynamics of the Nasal cycle, and potential diagnostic applications. This research article introduces a novel and cost-effective tool for measuring and characterizing nasal dominance through airflow.

Keywords: Nasal Dominance, Airflow Detection, Nasal Cycle, Svara Yoga, Chandra Svara, Surya Svara.

Introduction

Svara Yoga

Svara Yoga is one of the most ancient and traditional forms of Yoga [4]. Svara Yoga deals with the distribution of Prāṇa (vital force) in different parts of the body through subtle Prāṇik channels termed Nāḍīs [5]. The major teachings of Svara Yoga have been given in the classical text Śiva Svarodaya in the Sanskrit language, as a dialogue between Bhagwan Śiva and Devi Parvati [6]. Svara is described as the sound of breathing as Hamso which is divided into the sound of the inhalation as Ham and the sound of the exhalation as So [7][8]. Svara Yoga can be defined as the Yoga of Breath or the Science of Breath [9]. The understanding of Svar Yoga allows the practitioners to harness the breath as a means to achieve physical, mental, and spiritual well-being [10]. The flow of Prāṇa, the subtle vital force, is present in the subtle channels known as Nāḍī which are 72,000 in number originating from the center of the Nāḍīs

known as Kanda that is situated in the Sūkṣhma Sharīra somewhere around the navel of a person [11]. The movement of the Prāṇa in most of these 72,000 Nāḍīs is very subtle and hard to detect [12]. The Nāḍīs situated in the Sūkṣhma Sharīra around the nostrils are known as Idā Nāḍī and Pingala Nāḍī. Idā Nāḍī is related to the left nostril and the sound created by the left nostril is named Chandra Svara [13]. Pingala Nāḍī is related to the right nostril and the sound created by the right nostril is named as Surya Svara [14]. The frequencies of the sounds of these nostrils vary over a period representing the rise and fall of the Chandra and Surya Svara [15]. The Idā Nāḍī, and its Svara that is Chandra Svara is situated in the left nostril having a cooling-producing calming effect on the body and mind. Pingala Nāḍī, or the right nostril, is associated with the sun and is believed to be energizing and heating [15][17]. The balance and dominance of these two nasal passages play a crucial role in determining an individual's mental and physical state [17]. According to Svara Yoga, when one of the nostrils is dominant over the specific kind of effects are manifested, than the other, it indicates the dominance of either the cooling or heating energy in the body. This is the phenomenon evident as Svara alteration in Svara Yoga known as Svara Uday [18]. In the Western world, Keyser is said to be the first formal observer of this phenomenon who also termed it nasal cycle in 1895 [19].

The advancements in medical technology have allowed us to develop different modalities of investigations of the nasal cycle. Some of them are rhinomanometry, Peak Nasal Inspiratory Flow (PNIF) nasal endoscopy. However accurate detection of nasal dominance is still an unaddressed problem. There is a need for a low-cost device that detects nasal dominance accurately.

Nasal Dominance Measurement

Nasal dominance is the phenomenon where one nostril is more dominant in airflow and pressure than the other at any given time. This dominance changes over a period of time from one nostril to another. Studies suggest switching of these Nasal Dominance approximately phase length ranging from 30 min to 6h [20]. In right nasal dominance, the right nostril is more open, the airflow is smooth and free, and the left nostril tends to be relatively constricted, and vice versa. This rhythmic alteration of the nasal dominance is termed the nasal cycle [21]. In the same manner, Surya Svara is the condition when the right nostril is more open, the airflow is smooth and free, the left nostril tends to be relatively constricted and Chandra Svara is the condition when the left nostril is more open, the airflow is smooth and free, the right nostril tends to be relatively constricted. When the flow of the air in both nostrils is equal it is called Sushumna Svara [22].

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Objectives

The aim of this research is to investigate and measure the concept of human nasal dominance in the context of Svara Yoga.

- Developing a low-cost tool for nasal airflow detection and its dominance
- Assessing nasal dominance patterns among participants

Nasal Dominance Measurement

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Significance of Nasal Dominance in Svara Yoga

The ancient practices of Svara Yoga, also known as the science of breath, are based on the ideas of conventional Indian yogic philosophy. It highlights the importance of breathing as a fundamental mechanism that unites the body, mind, and consciousness [23]. The breathing pattern through the nostrils is very important for health and spiritual growth as per the tradition of Svara Yoga. The fundamental concept in Svara Yoga is the idea of "Nasal Dominance"[22][3]. It is believed that the breath flow in each nostril is associated with specific energetic pathways or Nāḍīs, namely, the Idā Nāḍī (connected to the left nostril) and the Pingala Nāḍī (connected to the right nostril). The central channel,

called the Sushumna Nāḍī, is associated with balanced breath flow through both nostrils and is the pathway to spiritual awakening.

The significance of nasal dominance in Svara Yoga can be understood from several perspectives: Svara Yoga as defined to be the study of breathing has different dimensions as Nasal dominance, the direction of the flow of nasal air, a form of the nasal vapor condensation, the volume of the air.

2.1 Mind-body Harmony

In Svara Yoga, it is believed that the left nostril (Idā Nāḍī) is connected to the mental faculties and is associated with qualities like calmness, receptivity, and relaxation. The right nostril (Pingala Nāḍī), on the other hand, is linked to the physical Faculties and is associated with qualities like alertness, activity, and dynamism. The balance between these faculties is essential for overall well-being and maintaining harmony in the body and mind [23].

Psychological Effect

It is said that breathing through the left nostril has a calming and cooling effect on the mind, fostering emotional equilibrium and a sense of serenity. The study suggested that after left nostril yoga breathing spatial memory scores increased [24]. As opposed to this, right nostril breathing is thought to stimulate the mind and improve alertness and memory. A study shows right nostril breathing facilitates better performance of inherent digit backward and digit forward span memory [25]. Svara Yoga practitioners can effectively change their mental and emotional states by comprehending and utilizing nasal dominance.

Health and Healing

According to ancient yogic writings, nasal dominance imbalance has been connected to several health problems. In contrast, excessive dominance of the left nostril (Idā) is linked to lethargy and sadness, while excessive dominance of the right nostril (Pingala) is linked to disorders like stress, anxiety, and hypertension. Individuals may be able to treat these health issues and advance general wellness by using specialized breathing techniques to balance nasal dominance [26]. Left nostril breathing has been related to anxiety-reducing effects of the left nostril [24].

2.4 Improved Spiritual Practice and Meditation

In the context of meditation, balanced nasal dominance is said to be quite beneficial. The Sushumna Nāḍī is thought to activate when the breath is evenly distributed across both nostrils, enabling the practitioner to enter higher realms of consciousness and spiritual experiences. Forced Alternate Nostril Breathing that is applied to activate Sushumna Nāḍī can balance the functional activity of the right and the left hemispheres [27].

2.5 Coping with Stress and Anxiety

Knowing one's nasal dominance allows one to adjust their yoga and meditation routines. For instance, practices that encourage balance of nasal dominance may be useful to help a person feel calm and relaxed if they are under a lot of stress. Anxiolytic effects are shown by the practice of Alternate nostril breathing in acute stressful situations [28].

3 Literature Review: Tools to Detect Nasal Dominance

There exist various methods for the detection of nasal dominance. The literature presents a range of instrumental methods to detect nasal dominance. Methods like acoustic rhinometry and Peak nasal inspiratory flow provide insights regarding the nasal airflow while acoustic rhinomanometry assesses nasal resistance. The Odiosoft Rhino converts nasal airflow-induced sound frequency into cross-sectional area measurements.

Table 1. Available devices for the detection of nasal dominance

S. N.	NAME	MEASUREME NT	KEY POINT	SPECIFICATIO N
1.	Peak nasal inspiratory flow (PNIF) [29]	Maximal per minute of forced nasal airflow	If there are airway obstructions PNIF can be affected	It may not capture normal breathing airflow and relies on correct instruction and patient cooperation.
2.	Acoustic rhinometry (AR) [30]	Cross-sectional area (CSA) at different distances from the nostril,	Rhino graph based on sound wave distortions, with highest accuracy	Useful for patients with obstructions like nasal polyposis or septal deviation

helping assess in the first 5-6 cm
nasal passages from the nostril
and volumes

3. Rhinomanometry (RM) [31] Simultaneously assessing trans nasal pressure and airflow A tachometer and a pressure transducer including resistance and work of breathing
4. Odiosoft Rhino (OR) [32] Converts nasal airflow-induced sound frequency into cross-sectional area measurements. Microphone and a nasal probe placed 1 cm from the nostril Stronger correlation with patient symptom scores compared to AR

Despite the given methods such as Peak Nasal Inspiratory Flow (PNIF), Acoustic Rhinometry (AR), Rhinomanometry (RM), and Odiosoft Rhino (OR), there remains a great need for the development of a low-cost device to detect nasal dominance. Controlled environments, trained personnel, patient cooperation, and specialized equipment are required for the existing methods to function. They are also costly and less accessible.

A cost-effective device that functions on the principle of airflow detection would make the assessment process easy and feasible to be widely applied in both clinical and non-clinical settings. Moreover, such a low-cost device could assist individuals in regularly monitoring their nasal dominance at home in their comfort. It promotes early detection and longitudinal profiling of the nasal dominance and nasal cycle that may be utilized for personalized interventions. This can reduce the burden on the system of traditional healthcare.

Methodology

Research Design

To assess nasal dominance, a low-cost tool based on nasal airflow detection was developed and tested. This tool measures the airflow through each nostril to determine the dominance pattern of the participants. The development of the nasal airflow detection tool was inspired by previous studies on similar devices for measuring nasal airflow [1]. Participants were recruited from IIT Mandi through convenience sampling. Inclusion criteria required participants to be healthy adult practitioners aged between 18 to 30 years, and free from any respiratory or nasal abnormalities that could affect nasal airflow. Prior to their inclusion in the study written informed consent was obtained from all participants.

The study protocol involved two main components:

(1) Experiment 1: Nasal airflow measurement of one nostril by closing the other and vice versa for 10 seconds for each nostril (this serves as an ideal case, where the flow from one of the nostrils is assumed to be zero)

(2) Experiment 2: Nasal airflow measurement of both nostrils simultaneously for 10 seconds. (this serves as a practical case, which immediately follows Experiment 1 (which assumes that the dominance is not changing in such a short period of time), where the flow from both nostrils is normal, and the device outputs about the dominance can be validated against that in Experiment 1)

Participants sat comfortably in a chair and breathed naturally through their nostrils while the device recorded the airflow patterns. Respiration Laterality Index (LI) was calculated as a measure of the ratio of flow between the nostrils using the method adopted by Kahana-Zweig, Roni, et al [1]. Respiration Laterality Index (LI) can be calculated as $(\text{Right Nostril Pressure} - \text{Left Nostril Pressure}) / (\text{Right Nostril Pressure} + \text{Left Nostril Pressure})$ for every certain period.

Nasal Airflow Detection Tool Development



Fig. 1. Schematic representation of the proof of concept.

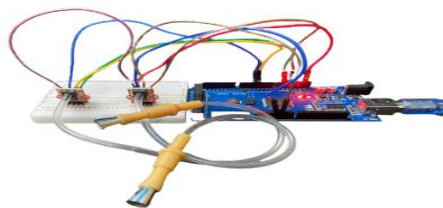


Fig. 2. Image depicting the developed proof of concept.

Sensor Selection

The HX710B pressure sensor, a high precision that is widely used in various applications for measuring pressure with stability and accuracy was selected. This sensor stability piezoresistive sensing element converts pressure variations into electrical signals. This becomes a good choice for both differential

pressure and absolute measurements. This sensor is of compact size, and low power consumption making it ideal for applications in our proof of concept.

Signal Processing

The HX710B pressure sensor is a highly accurate integrated circuit-based device utilizing a resistive bridge configuration. It was interfaced with an Arduino board for precise data acquisition.

To facilitate non-intrusive measurements of nasal airflow, a hollow conical piece was employed to securely house the sensor during experimentation. The conical piece was comfortably kept in the front of the nostril with close contact to ensure minimal discomfort for the participants.

Data Acquisition

Arduino sketch was used for data acquisition and processing leveraging the HX711 library to interface with the HX710B sensor. For a duration of 10 seconds, the Arduino sketch was programmed to conduct pressure readings at a specific interval of 10 milliseconds. Capturing the data with this high frequency the system could precisely capture subtle changes in nasal airflow.

Arduino in conjunction with the HX710B pressure sensor facilitates real-time data acquisition and allows for straightforward data processing making it a reliable and efficient system for studying nasal airflow dynamics and related parameters.

Data Collection

Participant comfort and relaxation are crucial for accurate study results. These sensors are connected to cannulas that are kept outside of the nostrils in proximity so that they can detect the inhaled and exhaled airflow properly.

If the sensors are placed inside the nasal cavity it may interfere with different variables like moisture and heat, affecting pressure readings.

To collect sufficient data the participants were instructed to breathe naturally through the cannula for a few seconds. The collected data is then presented in a graph format that presents pressure changes over time.

The nostril exhibiting higher pressure is easily identified as the dominant nostril. The sensors are positioned around 15-18 cm from the nostrils and connected to the cannula which is made of soft plastic or silicone for comfortable application.

There are various advantages to applying this method of data collection as it is simple and non-invasive. The connection of the sensor with the cannula removes the need for nasal insertion of the sensors, making the method feasible and requiring less patient cooperation.

As the sensors are low-cost and highly sensitive and can detect subtle pressure changes, this method becomes reliable and cost-effective. The clarity is further enhanced by its graphical representation of the collected data helping in easy identification of the dominant nostril.

Data Analysis

Respiration Laterality Index (LI): We are using the Respiration Laterality Index (LI) as a unit which is a measure of the ratio of flow between the nostrils. It can be calculated as:

$$\text{Respiration Laterality Index LI} = \frac{(\text{Right Nostril Sensor Value} - \text{Left Nostril Sensor Value})}{(\text{Right Nostril Sensor Value} + \text{Left Nostril Sensor Value})}$$

In the above equation, the sensor values are averaged over 10-second periods.

Based on this we define the following indications:

- If LI= 1, Only the Right Nostril is Dominant, Flow of the Left Nostril is Zero
- If $0 < \text{LI} < 1$, the Right Nostril is More Dominant over the Left Nostril
- If LI= -1, Only the Left Nostril is Dominant, Flow of the Right Nostril is Zero
- If $0 > \text{LI} > -1$, the Left Nostril is More Dominant over the Right Nostril
- If LI= 0, Both Nostrils are Dominant with Equal Flow

Mean LI: It is an average of the LI over a period. It can potentially represent the tendency of any subject to be in any nasal dominance over a period.

Data received by the uncalibrated sensors were divided by 1000000 and it was rounded off to two digits after decimal.

Results/Findings

The study collected two types of data related to nasal dominance from a sample of 7 participants. In one type of experiment, readings (Experiment 1) were collected after closing one nostril with the other nostril that was open. In the second experiment (Experiment 2) readings were taken simultaneously from both nostrils to observe natural airflow patterns. This process was repeated for the other nostrils. As indicated earlier, the results from the practical situation of Experiment 2, can be validated against the idealistic case of Experiment 1, to ascertain that each sensor is yielding similar values to that in Experiment 1, and the left and right sensors are not interfering with each other, in a normal breathing setting.

The analysis of the collected data is given in the form of graphs that depict the pressure changes in the nostrils over a period of 10 seconds. The sensor output values given in the Table below, are averaged over this interval. In the results below, there are two graphs for each sample showing the left and right nostrils of both experiments.

It is observed in the Table below, that columns 3 and 4, which are taken when both the nostrils are open, closely match the idealistic case depicted in the first two columns. The dominant nostril not only is identified correctly and consistently, but the sensor output values are also of the same order in both Exp 1 and Exp 2. The Nasal Dominance can also be identified with the score of LI, which, in these cases, essentially depicts that in realistic cases, one may not achieve a value very close to 1 or -1 (which is quite natural), and hence the order of L1 values used to associate dominance (for average humans), should be considered in ranges as achieved here.

Table 2. The 24-bit integer values received by the HX710B pressure sensor.

S.N.	Exp 1 Mean of R* N* (When L* was closed)	Exp 1 Mean of L N (When R was closed)	Exp 2 Mean of R N	Exp 2 Mean of L N	Exp 2 Me an LI
SAMPLE 1	5.18	4.38	5.20	4.37	0.0 9
SAMPLE 2	5.17	4.37	5.15	4.36	0.0 8
SAMPLE 3	4.44	5.44	4.55	5.27	- 0.0 7
SAMPLE 4	5.17	4.37	5.17	4.36	0.0 8
SAMPLE 5	4.40	5.52	4.39	5.70	- 0.1 3

SAMPLE 6	5.22	4.39	5.17	4.38	0.08
SAMPLE 7	5.17	4.50	5.36	4.43	0.09

In this table, R= Right, L*= Left, N*= Nostril*

In addition to the Table, which gives the average values, the graph below also depicts the actual sensor outputs. At the outset, we find that the variations in the signals are also very smooth, show consistent patterns of relative amplitude and frequencies, and do not show noisy variations. This is indeed a desirable quality for a sensor. More insights about the characteristics and patterns of the signals are given below for each of the samples individually.

Visual analysis of the signal outputs

The experiment measures the Respiration Laterality Index (LI) of the airflow of the right and left nostrils during respiration. The LI quantifies the airflow distribution, ranging from -1 (left nostril dominance) to 1 (right nostril dominance), with 0 representing balanced airflow.

. **Sample 1:** Experiment 1 LI is approximately 0.083, suggesting a slight tendency for right nostril dominance. Experiment 2 LI is similar, indicating a similar level of lateralization during simultaneous airflow measurements.

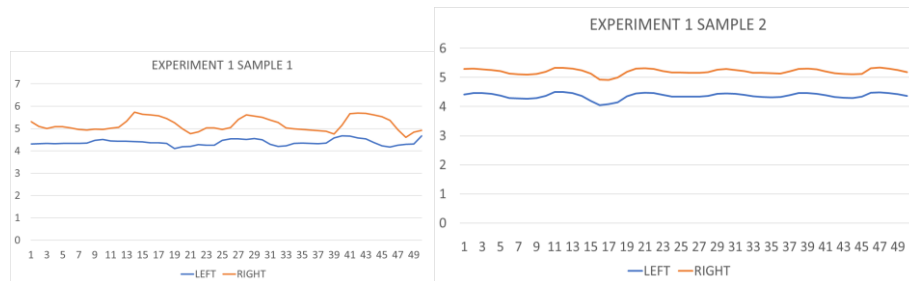


Fig. 3. Right Nostril Sensor having higher frequencies **Fig. 4.** Right Nostril Sensor having higher frequencies.

Sample 2: Experiment 1 LI is approximately 0.084, indicating a slight tendency for right nostril dominance. Experiment 2 LI is slightly higher, suggesting a slightly increased right nostril dominance during simultaneous measurements.

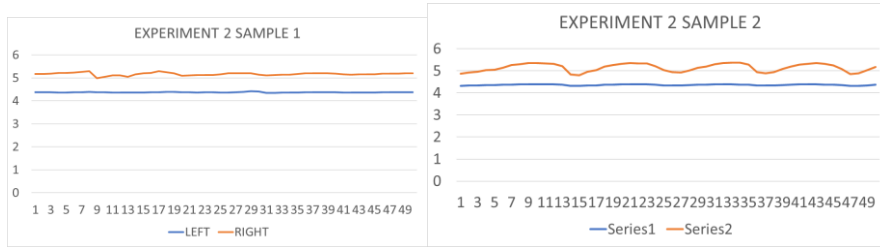


Fig. 5. Right Nostril Sensor having higher frequencies **Fig. 6.** Right Nostril Sensor having higher frequencies.

Sample 3: Experiment 1 LI is approximately -0.110, indicating a tendency for left nostril dominance. Experiment 2 LI is even lower, suggesting a more pronounced left nostril dominance during simultaneous measurements.

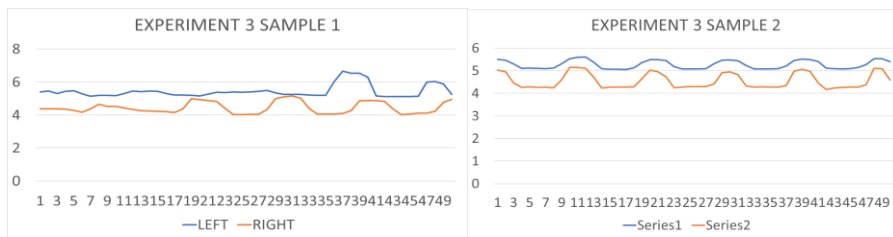


Fig. 7. Left Nostril Sensor having higher frequencies **Fig. 8.** Left Nostril Sensor having higher frequencies.

Sample 4: Experiment 1 LI is approximately 0.083, indicating a slight tendency for right nostril dominance. Experiment 2 LI is slightly higher, suggesting a slightly increased right nostril dominance during simultaneous measurements.

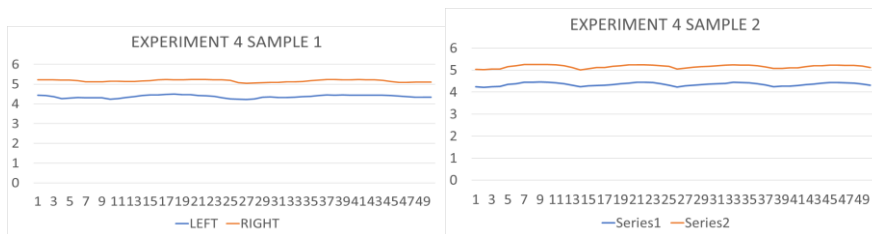


Fig. 9. Right Nostril Sensor having higher frequencies. **Fig. 10.** Right Nostril Sensor having higher frequencies.

Sample 5: Experiment 1 LI is approximately -0.101, indicating a tendency for left nostril dominance. Experiment 2 LI is higher but still negative, suggesting left nostril dominance during simultaneous measurements, although less pronounced.

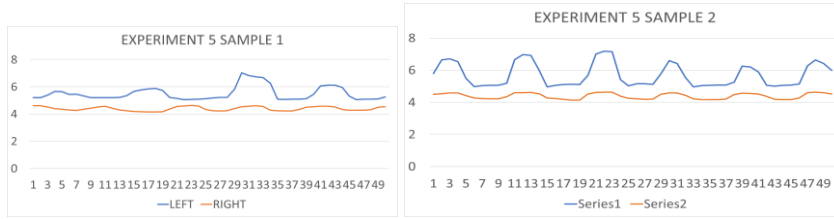


Fig. 11. Left Nostril Sensor having higher frequencies. **Fig. 12.** Left Nostril Sensor having higher frequencies.

Sample 6: Experiment 1 LI is approximately 0.087, indicating a slight tendency for right nostril dominance. Experiment 2 LI is slightly lower, suggesting a slightly reduced right nostril dominance during simultaneous measurements.

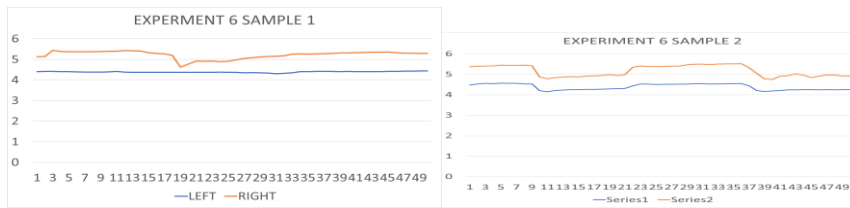


Fig. 13. Right Nostril Sensor having higher frequencies. **Fig. 14.** Right Nostril Sensor having higher frequencies.

Sample 7: Experiment 1 LI is approximately 0.061, indicating a slight tendency for right nostril dominance. Experiment 2 LI is higher, suggesting an increased right nostril dominance during simultaneous measurements.

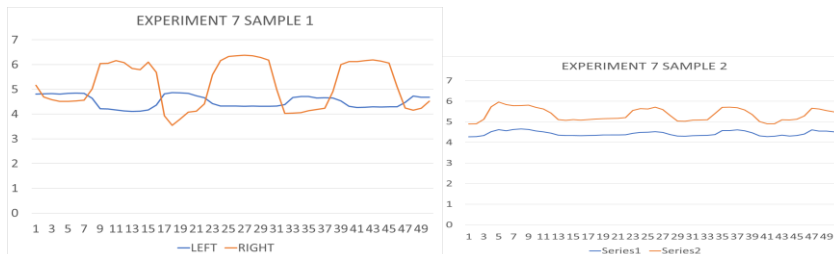


Fig. 15. Right Nostril Sensor having higher frequencies. **Fig. 16.** Right Nostril Sensor having higher frequencies.

Overall, the LI values in Experiment 1 and Experiment 2 are relatively consistent for most samples, with slight variations in the extent of nostril dominance.

Interpretation of Nasal Dominance

Table 3. Classification of the samples based on Nasal Dominance.

Samples with Right Nostril Dominance	Samples with Left Nostril Dominance	Samples with Balanced Lateralization
None of the		
Sample 3: provided samples		
Sample 1: Experiment 1 LI $\approx$ 0.083, Experiment 2 LI $\approx$ 0.082	Experiment 1 LI $\approx$ -0.110, Experiment 2 LI $\approx$ -0.126	have LI values very close to 0, suggesting perfect balance.
Sample 5:		
Sample 2: Experiment 1 LI $\approx$ 0.084, Experiment 2 LI $\approx$ 0.087	Experiment 1 LI $\approx$ -0.101, Experiment 2 LI $\approx$ -0.074	
Sample 4: Experiment 1 LI $\approx$ 0.083, Experiment 2 LI $\approx$ 0.085		
Sample 6: Experiment 1 LI $\approx$ 0.087, Experiment 2 LI $\approx$ 0.082		
Sample 7: Experiment 1 LI $\approx$ 0.061, Experiment 2 LI $\approx$ 0.094		

Table 4. Classification of the samples based on Svara.

Samples with Surya Svara States	Samples with Chandra Svara States	Samples with Svara Transition	Potential towards Sushumna Svara
Sample 1: Both Experiment 1 and Experiment 2 indicate a slight tendency for right nostril dominance indicating Surya Svara.	Sample 3: Both Experiment 1 and Experiment 2 indicate a	Sample 5: Both Experiment 1 and Experiment 2 indicate a tendency for left nostril	Both

Sample 2: Both Experiment 1 and Experiment 2 suggest a slight tendency for right nostril dominance indicating Surya Svava. tendency for left dominance, although it's less pronounced in Experiment 2. This sample could be in a transition between Chandra Svava and Sushumna Svava.

Sample 4: Both Experiment 1 and Experiment 2 suggest a slight tendency for right nostril dominance indicating Surya Svava.

Sample 6: Both Experiment 1 and Experiment 2 suggest a slight tendency for right nostril dominance indicating Surya Svava.

Sample 7: Both Experiment 1 and Experiment 2 suggest a slight tendency for right nostril dominance indicating Surya Svava.

Overall, we believe that, although this is an initial PoC, the findings signify the importance of a low-cost tool. The detected nasal dominance offers holistic monitoring of one person's individual Svava and points towards a practical order of values and patterns of variances over a period. More studies in the future, considering longer periods, and correlating with other factors, can help the individual to understand their energy flow and overall well-being in the context of practices like Svava Yoga.

Discussion

The research presented in the article shows the importance of nasal dominance and its detection in the context of Svava Yoga. Svava Yoga has been described as an ancient school of yoga that deals with the Svava which are majorly represented by nasal dominance.

According to Svava Yoga principles nasal dominance correlates with the flow of Prāṇa (life force energy) in different Nāḍīs. When Prāṇa flows in the Idā Nāḍī situated in the left nostril Chandra Svava dominates and as a result, the left nostril becomes dominant. In the same manner, when Prāṇa flows in

the Pingalā Nāḍī situated in the right nostril Surya Svara dominates and as a result, the right nostril becomes dominant.

The low-cost tool introduced in this article gives valuable insights for the detection and characterization of nasal dominance and corresponding Svara.

The nostril that yields a higher sensor output is identified as the dominant nostril and the corresponding Svara is said to be active which provides the practitioners a deeper understanding of their autonomic activity and Prāṇa distribution enabling overall well-being. Identification of correct Svara is a very tedious task for yoga practitioners and often its measurement is nearly subjective. The tool introduced in this article solves the problem and provides a handy and feasible method.

The non-invasive and simple data collection methodology using the cannula and pressure sensors ensures participant comfort and reliable results. This approach enables practitioners to observe real-time graphical representations of pressure changes in both nostrils. The ability to save and analyze the data over time offers an opportunity for further research on the dynamic nature of nasal dominance in different situations or practices. Future variants of such a tool with more experiments and correlations with other factors can aid yoga practitioners in optimizing their Nāḍīs leading to an enhanced flow of Prāṇa providing well-being and spiritual development.

The tool also has potential diagnostic applications in clinical settings, as it requires less patient cooperation and offers accurate detection of nasal airflow and dominance, providing valuable information for the assessment of an individual's health status. Further exploration of the tool's diagnostic capabilities may open new avenues in complementary medicine and holistic well-being.

1 Limitations

The study presents a low-cost PoC for measuring nasal dominance through airflow patterns, using an uncalibrated sensor. However, we understand that this was an initial but encouraging effort. The planned improvements in the near future include increasing the sample size, addressing potential bias in participant selection, calibrating the sensor to fine-tune the pressure range, longer durations involving changes in Svara, and correlating with other physiological factors to provide more fundamental insights. Additionally, the sensor's long-term stability and applicability to other practices are uncertain.

2 Future Implications and Work

Calibrating the low-cost tool for precise measurements, refining its accuracy and usability. Exploring diagnostic applications and investigating the further correlations between nasal dominance and Svara Yoga will deepen our understanding of well-being. Longitudinal studies tracking changes in nasal dominance and integrating the tool with digital platforms for personalized feedback will promote overall wellness through effective Svara Yoga interventions.

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Yoga and cardiorespiratory regulation: investigations using cardiac autonomic functions in healthy subjects and patients with neuropsychiatric disorders

Kaviraja Udupa¹, Hemant Bhargav², Talakad Sathyaprabha³.

¹ Dept of Neurophysiology, NIMHANS

² Dept. of Integrative Medicine, National Institute of Mental Health and Neuro Sciences (NIMHANS), Shivarama Varambally (Dept. of Integrative Medicine and Psychiatry, National Institute of Mental Health and Neuro Sciences (NIMHANS)

³ Dept of Neurophysiology, NIMHANS

Abstract:

The practice of yoga prepares the body and mind to attain higher levels of consciousness. This is primarily achieved by controlling the autonomic nervous system which is involved in the regulation of activities of visceral systems (not usually under voluntary control). Yogis tend to use the respiratory system, which being semi-voluntary in nature acts as the key to attaining this voluntary control over the autonomic nervous system (ANS). Heart Rate Variability (HRV), which computes the instantaneous changes in heart rate over time, is a good measure of cardiac autonomic balance. It is imperative to have respiration under normal pattern (12-15 breaths/min taking 5-6 seconds for each respiratory cycle) to compute Sympatho-Vagal Balance (SVB) which measures the neuro-cardiac control through these two limbs of ANS. In this review, we summarize several research studies undertaken at NIMHANS and other institutions demonstrating modulation of sympathovagal balance through the practice of pranayama, based on the frequencies of breathing (slow vs fast), patterns of breathing (puraka, kumbhaka, rechaka, shunyata in various ratios), special breathing techniques (nadi shuddhi, Pranav or AUM chanting, bhastrika..) in healthy subjects as well as in various neurological and psychiatric conditions. For example, AUM chanting has been shown to acutely increase the vagal tone, suggesting that regular yoga practice would enhance the vagal tone facilitating calmness, relaxation, and resilience which are the hallmarks of a Yogi. Further, we also discuss specific nostril breathing using HRV measures, to demonstrate how Surya (right) and Chandra (left) Nadi control the two limbs of ANS, thus attaining ideal SVB. In addition to the modulation of autonomic functions, other possible mechanisms will also be discussed based on other parameters employed in these studies such as neurophysiological measures, imaging, serum levels of neurotropic factors, neurohormone, and other biochemical variables. In summary, the presentation aims to demonstrate how yoga, especially pranayama, achieves SVB, samatvam (equanimity or balance) of ANS will be demonstrated using various

neurophysiological experiments in healthy subjects as well as in patients with various neurological and psychiatric disorders. Future studies of such alterations in Siddha Purushas would unravel many of the mystiques related to higher levels of consciousness achieved by Yogis.

Investigating the Impact of Rudram Mantra Listening on Brain Activity: A Scientific Exploration

Ashok Mahato¹, Kritiprasanna Das¹, Ram Bilas Pachori¹, Vikram M Gadre², Dipika Das Mahapatra³

¹Department of Electrical Engineering, Indian Institute of Technology Indore, Indore 453552, India

²Department of Electrical Engineering, Indian Institute of Technology Bombay, Mumbai 400076, India

³Sri Sri Institute for Advanced Research, Art of Living International Centre, Bangalore 560082, India

Abstract:

Meditation and mantra chanting have long been recognized for their positive effects on our minds and emotions. Recently, scientists have started investigating how these practices impact our brains. The Rudram Mantra is a sacred chant in the Hindu tradition. When people chant or listen to it with devotion, they often feel a special energy or vibration. This energy is believed to bring positivity to those who chant and even to those who listen to it. Many people have experienced a deep sense of peace and connection during and after Rudram Mantra chanting. Our research focuses on understanding the effects of listening to the Rudram Mantra, a special chant from the Vedas associated with Hindu spirituality. We aim to uncover how this mantra influences our brain activity, thoughts, and emotions through electroencephalography (EEG) signals obtained from the human brain. EEG measures the brain's electrical signals using electrodes placed on the scalp. These signals are grouped into different brainwave frequencies, each linked to specific mental and emotional states. Delta waves (0.5–4 Hz) are linked to deep sleep and relaxation. Theta waves (4–8 Hz) are associated with relaxation, creativity, and meditation. Alpha waves (8–13 Hz) indicate a relaxed and alert state. Beta waves (13–30 Hz) are related to active thinking and decrease during meditation. Gamma waves (30–100 Hz and beyond) are connected to advanced cognitive functions and clear thinking. Various studies show that meditation can lower the heart rate, improve breathing, and make the skin less tense, all of which help us relax. In one study, chanting the Hare Krishna Mantra in meditation increased a kind of brain wave linked to feeling calm. Different meditation methods, like Kirtan Kriya, also have benefits such as reducing anxiety and improving sleep health. In existing works research using wavelet transform-based works have demonstrated that OM chanting can help to improve attention and concentrate in better way, which is helpful for managing stress and improving overall mental health. To the best of our knowledge, the existing research has not explored into the impact of reciting or listening to the Rudram Mantra on brain activity, specifically through EEG signal analysis. In order to examine how listening to Rudram Mantra affects the human brain, we have carried out recording of EEG signals before and after listening. Our

study involved 8 participants, including 5 males and 3 females, aged between 18 and 35 years. All participants had no history of neurological disorders and voluntarily took part in the experiment. In the experimental setup, we have used BIOPAC MP150 data acquisition system and an EEG 100C amplifier to collect EEG data from 8 participants. This system recorded the brain's electrical signals at a sampling rate of 1 kHz. We have used a total of 10 channel EEG electrodes, strategically placed to cover most scalp part of the brain. These electrodes were located at positions Fp1, Fp2, F3, F4, T3, T4, P3, P4, O1, and O2, with the Cz electrode serving as a reference point for our EEG recordings. In our work, for better data quality, we have applied filters during the signal collection process to remove noise and trends. The amplifier was set to a gain of 20,000 to amplify the signals appropriately. To understand the changes in brain activity, we extract most significant band power features (delta, theta, alpha, beta, and gamma), the Higuchi fractal dimension (HFD), and Shannon entropy (SEN). This feature attribute allows us to track the band power and complexity of the brainwaves while participants listen to the Rudram Mantra. Initially, some preprocessing steps were necessary for the EEG signals prior to feature extraction and analysis. Through this study, we have observed significant changes in the brain activity of people during Rudram Mantra listening practices. This analysis reveals a notable increase in band power within the delta and theta ranges, along with a decrease in beta and gamma bands, signifying enhanced concentration and focus on thoughts related to mental well-being. During mantra listening, we have observed slight fluctuations in both HFD and SEN feature metric which reveals significant changes in the subject's brain activity patterns. The objective of proposed work to understand how Rudram Mantra influences individual brain activity through EEG signal analysis and develop the novel feature which shows better correlation to brain activity to capture this change. In future work, the proposed study can be extended to investigate the impact of the Rudram Mantra on a larger participant group and explore additional feature attributes, thereby enhancing its relevance and applicability across various neurological applications.

Theoretical Framework of Neuro-Sequential Cognitive Response in Trading Decision in Financial Market – A Quantum Cognition of “Mantra-Vigyan”

Nitin Kulshrestha¹, Sanjay Rastogi¹

¹ Christ University Delhi NCR

Abstract:

The brain automatically and unconsciously does many things before a decision is made and agents are aware of it. Neuro-finance combines financial theories with psychology, and neuroscientific insights to explain, in an interdisciplinary way, the widespread irrationality in the behavior of trading decision in equity market (Reggitte et al, 2021). The idea to write this paper is to understand the integrative and conceptual viewpoint of Neuro-sequential cognitive response in trading decision. The objective of this research is to understand the conceptual framework of “Brain response to trading decision” in equity market. Our trading decision making is the combination of four factors i.e. reflexive response, analytical response, reactive response, emotional response. In different circumstances, these four factors have a dynamic response to share market trading decision. Here, trading decision is an endogenous variable and four factors play an exogenous variable (reflexive response, analytical response, reactive response, emotional response). The role of emotion, mental status, biases, stress, personality, gender, age, and experience is therefore we detected and analyzed using different non-invasive clinical tools (i.e., fMRI, TMS, EEG, heart rate measurement, skin conductance detection, eye-tracking, hormone level measurement) to understand the dynamics of neuro-sequential cognitive response to trading decision. This research paper presents a theoretical framework that explores the concept of Neuro-Sequential Cognitive Response (NSCR) in trading decisions within the equity market. We delve into the innovative approach of Quantum Cognition of “Mantra-Vigyan” (Indian Knowledge System) to gain insights into the cognitive processes that influence traders' decisions. By analyzing the neuro-sequential aspects of decision-making, we aim to provide a deeper understanding of the psychological and sequential elements that underlie trading behavior in the stock market. We use Smart-PLS for proposed research.

Altered States of Consciousness during Yoga Nidra: An fMRI Study of Thalamic Connectivity

Suruchi Fialoke ¹, Vaibhav Tripathi², Sonika Thakral³, Anju Dhawan ⁴, Vidur Mahajan⁴, Rahul Garg⁵

¹Indian Institute of Technology, Delhi

²Psychological and Brain Sciences, Boston University, Boston

³Department of Computer Science, Shaheed Sukhdev College of Business Studies, University of Delhi

⁴National Drug Dependence Treatment Centre, All India Institute of Medical Sciences (AIIMS), Delhi, India,

⁵NRCVEE, School of Information Technology, Computer Science and Engineering, Indian Institute of Technology, Delhi

Abstract:

Yoga Nidra, an ancient yogic practice, has been recognized for its potential to induce altered states of consciousness characterized by deep relaxation, heightened self-awareness, and the progressive mastery of profound meditative states. Simultaneously, clinical research has established the positive impact of Yoga Nidra on physiological and mental well-being. However, the neural mechanisms underlying these effects remain largely unexplored.

In this study, functional Magnetic Resonance Imaging (fMRI) is utilized to examine the functional connectivity of the thalamus during the practice of Yoga Nidra. As a vital sensory relay center in the brain, the thalamus serves as a crucial hub for relaying sensory information (excluding olfaction) and establishing reciprocal connections with the cortex, earning its reputation as the "gateway to consciousness." The connectivity of the thalamus plays a critical role in regulating sleep and wakefulness states, as well as in altered states of consciousness observed through sedation or in various psychiatric disorders. We propose that the state of Pratyahara (withdrawal of senses) induced by the practice of Yoga Nidra in seasoned practitioners may result in a unique engagement of the thalamus, distinct from the usual resting conscious state.

The examination of fMRI scans from thirty experienced yoga practitioners unveiled a unique pattern of thalamic functional connectivity during the silent phase of Yoga Nidra practice in contrast to a comparable resting state. This silent phase, occurring towards the conclusion of a 20-minute audio-guided Yoga Nidra session, lacked explicit instructions and closely resembled an eye-closed resting

state. Remarkably, enhanced connectivity between thalamic regions and the brainstem was observed during Yoga Nidra practice in contrast with the awake resting state. This heightened connectivity may reflect an altered physiological regulation and alertness during the practice of Yoga Nidra. On the other hand, we noted a reduction in FC between thalamic regions and several cortical regions such as temporal regions, and posterior cingulate cortex (PCC), including areas known for their role in memory retrieval and default mode networks. This could suggest an intense state of relaxation during Yoga Nidra, potentially accompanied by diminished self-referential thinking, ruminating, and mind-wandering.

In comparison to states of rest, reduced thalamocortical connectivity can be observed in all stages of non-rapid eye movement (nREM) sleep, coma, and general anesthesia. This suggests that Yoga Nidra may be inducing a profoundly relaxing state. Additionally, an intriguing discovery is the increased connectivity between the thalamus and the brain stem during Yoga Nidra, indicating a state of deep relaxation coupled with heightened internal awareness. These novel insights not only considerably augment our neurophysiological comprehension of Yoga Nidra but also underscore the pressing need for more extensive research to fully understand and interpret the possible therapeutic implications of these observations.

Encoding a Secondary Intention can Increase Aftereffects in Prospective Memory

Snigdha Ayyagari¹, Naveen Kashyap¹

¹ Indian Institute of Technology, Guwahati

Abstract:

The field of prospective memory has received a lot of attention and importance in research, but there is limited understanding of what happens to an intention after its completion and if there are any aftereffects. One of the first experiments that dealt with aftereffects of intentions was the study by Marsh, Hicks and Bink (1998). They saw in a lexical decision task that response latencies were longer for material associated with completed scripts in comparison with neutral scripts. This shows that there is some persisting activation even after intention completion. Findings from Forster et al., (2005) show that accessibility of target-related material is higher when the task is yet to be fulfilled and decreases after the task is fulfilled. This indicates some sort of deactivation process. On the other hand, suspended intention or zero-target intentions (encoded as PM cues but not encountered during active phase) behaved differently from completed intentions in regard to aftereffects because of intention-fulfillment effect (Bugg et al., 2013; Bugg et al., 2016). Also, in real-life setting most of our intentions are not formed in isolation. They are parts of complex over-arching goals and we often have multiple pending intentions simultaneously. Only three studies so far have attempted to understand this complexity in the study of prospective memory. Anderson and Einstein (2017) were the first to introduce a secondary intention in an attempt to see what factors can cause intention deactivation. They found that in all three of their conditions; more clarity of task completion instructions, pre-task instructions that 'Only one target will appear and then the task is finished', and a new prospective memory target encoding, there was no deactivation found. Walser et al., (2017) used a repeated cycles paradigm, with 12 cycles of PM-Block and Test-Block. They found that aftereffects reduced when the cues differed between the two blocks (symbols vs. words). They also saw that aftereffects vanished in conditions in which participants did not perform a new PM task. Kurtz et al., (2022) also found that a retrieval set heightens commission errors by orienting responses to all deviant stimuli. All of these studies used the 'active phase- finished phase' paradigm. In this paradigm, there is an active phase during which an intention is encoded and to be executed. After the completion of the intention, another phase begins called the finished phase during which the target stimuli are encountered again. However, the target stimuli are no longer relevant in the finished phase. There can be a single active phase followed by a single finished phase or there can be repeated cycles of one after the other. A limitation in all the studies so far is the

ongoing task of the active phase and that of the finished phase is different and there are differences in focality of the PM targets. These kinds of context and processing changes are seen to influence the aftereffects of prospective memory. Also, neither of the studies differentiate between suspended and completed intention despite research showing that suspended intentions behave differently. The current study investigated the effect of encoding a secondary intention on the aftereffects of PM for both suspended and completed intentions. Forty five participants were randomly assigned to either experimental or control conditions. In the experimental condition, participants encoded a secondary intention in the finished phase of the task. In the control condition, participants did not encode any additional instructions. Commission errors and response latencies were analysed in the finished phase for fulfilled intentions or encoded but unfulfilled (suspended) intentions. In the experimental condition, with the presence of secondary intention commission errors occurred in 22% of the trails, while they only occurred in 15% of trails in control condition. Commission errors were higher for suspended targets than repeat targets in experimental condition. No such difference was noted in the control condition. Independent samples t-test gives a t-value of -3.198 with mean of reaction time for suspended targets in experimental condition 1819.13ms and SD 820.198ms. In control condition, the mean reaction time for suspended targets was 1068.33 and SD 637.335ms. We also find a significant difference ($t=2.611$) between reaction times for Repeat PM Cues that reappear in the finished phase after instructions of the task being complete. The mean RT in the experimental condition is 1971.55ms (SD = 902.82) and 1500.51ms (SD = 679.27) in control condition. We find evidence of slower response times in the presence of secondary intentions. When participants encountered suspended or completed intentions in the finished phase of the experimental condition, they are monitoring for the new PM Target cues. This relevance may encourage target monitoring at a general level or retrieval mode (Walser et al., 2017; Guynn, 2003). We find support for increase in intention interference with a secondary intention in comparison to control. Commission error rates being higher for suspended targets may be attributed to anticipatory monitoring as participants monitor for the target during active phase but the target does not occur. This finding reflects that of Bugg et al., (2013) who found more commission errors in a zero-target condition than a four-target PM condition. Higher accessibility of suspended targets (as evidenced by lower RTs) can be explained by the Zeigarnik effect (Zeigarnik, 1938), creating a tension due to pending action towards a once relevant target, leading to the spontaneous retrieval. The current study helps clarify the role of secondary intention in aftereffects as the design of the study keeps the ongoing task constant between the active and finished phases. The PM targets and PM responses also remain same making it clear that slowing of responses can be attributed to retrieval mode or general level responding to all deviant stimuli.

Impact of Isha Sukha Kriya Practice on Brain Dynamics: An EEG Study

Saketh Malipeddi¹, Arun Sasidharan², Seema Mehrotra³, John P John⁴ and Bindu M Kutty⁵.

¹PhD scholar, Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

²Scientist C, Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

³Professor, Dept. of Clinical Psychology, NIMHANS

⁴Professor, Multi-modal Brain Image Analysis Laboratory, Dept. of Psychiatry, NIMHANS

⁵Professor, Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

Abstract:

Yoga is becoming more popular around the world. The brain oscillations underlying pranayama, on the other hand, are less well understood. This EEG study investigates the impact of Isha Sukha Kriya practice on brain dynamics among advanced and novice Isha meditators compared to meditation-naïve controls. Results show increased delta and theta power in controls during pranayama, while Isha meditators display increases in both low and high-frequency bands. Novice meditators exhibit global power increases, while advanced practitioners show more localized changes. Notably, advanced meditators have lower power differences between rest and pranayama, indicating an effortless pranayama process. The study emphasizes the importance of pranayama as a practice to calm the mind and serve as a preparatory practice for meditation sessions, and it backs up traditional wisdom. Understanding pranayama's neural effects can aid therapeutic applications for overall well-being and cognitive function.

Nap influenced task-related neural oscillations differentially in young and old individuals

Safoora Naaz¹, Rahul Venugopal¹, Gulshan Kumar¹, Arun Sasidharan¹, Ramajayam Govindaraj¹, T. N. Sathyaprabha¹, P. T. Sivakumar¹, John P. John¹, Bindu M Kutty and Ravindra P N¹.

¹National Institute of Mental Health and Neurosciences

Abstract:

Introduction: Sleep is a critical biological process that is essential for cognitive function, memory consolidation, and overall health. Napping is a short period of sleep during the day that can provide a number of benefits, including improved alertness, mood, and performance. However, the effects of napping on brain activity may vary with age. In this study, we investigated the effects of napping and cognitive load / demand on EEG power in young and old adults. **Materials and Methods:** Young (n = 10, aged 22 to 34 years, mean age 25.4 ± 4.67) and Old (n = 10, aged 50 to 65 years, mean age 57.6 ± 4.99) subjects. The study was done using 19 EEG electrodes in Nihon Kohden. Resting EEG data for 6 minutes (2x [2 minutes with eyes closed and 1 minute with eyes open]) was acquired twice before the nap (once before the cognitive task and once after the cognitive task) and twice after the nap (Figure 1). Only the resting EEG data with eyes closed was used for analysis. Preprocessing was done using EEGLAB and power spectral density analysis was carried out using MATLAB. The Welch's PSD was estimated for the following frequency bands: 'Delta' (0.5 - 4 Hz), 'Theta' (4 - 8 Hz), 'Alpha' (8 - 12 Hz), 'Beta' (16 - 30 Hz), and 'Gamma' (30 - 40 Hz), using a 4-second window size with a 50% overlap on the frontal (FP1, FP2, F7, F3, FZ, F4 & F8), central (C3, CZ & C4), temporal (T7 & T8), parietal (P7, P3, Pz, P4 & P8), and occipital (O1 & O2) electrodes. **Statistical analysis:** Descriptive statistics, t-test and RMANOVA was done using Jamovi (2.3.21) with $p=0.05$ as level of significance. **Results:** Pre-nap, both groups displayed no noteworthy changes in any of the spectral bands before and after completing the cognitive task. Post-nap, the younger group exhibited a reduction in delta power, although it did not reach statistical significance. On the other hand, the older individuals demonstrated a significant increase in delta power in the frontal region. In terms of theta power, a significant reduction was observed in the frontal, temporal, and central regions among young participants, but not among the older individuals, when compared to the pre-nap measurements. Regarding beta power, a significant reduction was observed in the central region among the younger group, while no change was noted in the older group. In terms of gamma power, an increase was observed in the frontal region among the older individuals, whereas no change was noted among the younger group when compared to the pre-

nap measurements (Table 1). After the nap, following the cognitive task, there was a significant reduction in the spectral power of delta, theta, and beta at the central region among the older adults. Conversely, no significant change was observed in the younger adults' spectral power as compared to before the task. Discussion: The findings suggest age-related differences in the effects of napping on EEG spectral power, particularly in the delta, theta and gamma frequency bands (Figure 2). Delta and theta power in naps appear to generally contribute to the same homeostatic processes as night sleep (D. J. Dijk et al., 1987). Younger adults show decrease in delta and theta power post-nap indicating normal homeostatic functions. But the OLD group shows the increase in delta power may be attributed to sleep inertia, possibly indicating impaired homeostatic regulation of sleep and it is reduced after the cognitive task. After the nap, older individuals required more effort to focus or perform the cognitive task, which might explain the observed increase in gamma power. The cognitive task is influencing the spectral changes in delta and gamma bands after the nap especially in elderly and specifically at the frontal region.

Effect of gravity on brain oscillations during yoga-based posture (Shirshasana)- a case study

Megha Pundir¹, Ramajayam Govindaraj², Prerana Reddy³, Arun Sasidharan⁴ and Sanjib Patra¹.

¹Central University of Rajasthan, Ajmer, Rajasthan, India

²National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India

³JSS AHER, Mysore

⁴National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India), Safoora Naaz
(National Institute of Mental Health and Neurosciences, Bengaluru, Karnataka, India)

Abstract:

Introduction: Shirshasana is a type of headstand posture of yoga in which the body is completely inverted. It is performed with or without wall support and it allows the brain to gradually adapt to the extra pressure in the head when the body is inverted. The present study aimed to investigate the effect of Shirshasana on brain oscillations using 4 channel portable electroencephalograph (EEG).

Methods: Three participants with varying levels of yoga experience were recruited from the NIMHANS campus for this study. Participant 1 (S1) had twelve years of yoga experience, participant 2 (S2) had seven years of yoga experience, and participant 3 (S3) had four years of yoga experience. The xAMP L 10 portable EEG system was used for recording the EEG. Electrodes were placed at Fp2, Fp1, F7, and F8 positions according to the 10-20 system. Each participant was instructed to sit on a chair with closed eyes for 3 minutes as a baseline condition, followed by performing Shirshasana with closed eyes for 3 minutes. EEG data were collected during both conditions. The EEG data were analysed using MATLAB tools to examine changes in brain oscillatory activity.

Results: The findings revealed that there is decrease in theta power in all subjects {S1($t=8.28$, $p\text{ value} < 0.001$); S2 ($t=3.24$, $p=0.001$); S3 ($t=7.79$, $p < 0.001$)} irrespective of their number of years of yoga experience while doing Shirshasana. The results have shown that gamma activity is increased while Shirshasana in intermediate proficient yoga practitioner {S2 ($t=-2.87$, $p=0.004$)} whereas it was decreased for proficient practitioner {S1($t=15.48$, $p < 0.001$)} when compared with sitting position. Our data revealed a considerable and significant decrease in EEG spectral power of Alpha ($t=6.42$, $p < 0.001$) and beta power ($t=13.62$, $p < 0.001$) for proficient yoga practitioner in Shirshasana compared to sitting position.

Discussion: Present study is an exploratory study and tried to assess the relationship between the gravity and EEG power spectrum. This study demonstrates common & differential EEG power spectral changes based on proficiency of practice. As headstand partially simulates microgravity situation, these findings

have practical implications in the context of microgravity, for preparing space craft travellers before space journey.

Can the interplay between EEG and ECG features help unravel the mind-body interaction problem in chronic pain?

Marigowda Vrinda¹, Sasidharan Arun², Desai Geetha², Bindu Kutty².

¹Axxonet Brain Research Laboratory, Axxonet System Technologies Pvt. Ltd., Bengaluru

²National Institute of Mental Health and Neuro Science, Bengaluru

Abstract:

Background: Decades of research have shown Chronic non-organic pain is a disease of mind-body interaction (1) characterized by extended periods (>3 months) of pain and often associated with various comorbid conditions or injuries. The mind-body interaction approach recognizes that the perception of pain is not solely determined by physical factors, but also influenced by emotional and cognitive aspects making it a multifaceted and challenging condition to address comprehensively. The current treatment strategies focus on only addressing physical symptoms of chronic pain. Understanding the above-mentioned interconnected elements is crucial in developing effective and holistic approaches to manage and treat chronic pain for enhanced patient well-being and improved outcomes. From a Neurophysiology standpoint, mind-body interaction could be roughly captured from the interplay between brain activity (like interaction among brain regions) and physiological activity (like autonomic influence on the heart). Accordingly in this study, we tried to capture the mind-body interaction of chronic pain subjects using combined data from EEG (Electroencephalogram) and ECG (Electrocardiogram), during a ‘cognition-emotion conflict’ task.

Materials and Methods: Sixteen chronic pain subjects (Male=9, Female=7) from NIMHANS Psychiatry OPD and fourteen age, gender and education-matched control subjects (Male=7, Female=7) from the local community participated in this study after their written informed consent and the institute’s ethics committee approval. To capture the ‘cognition-emotion conflict’, we used our lab-developed paradigm called Emo-ANGEL (Emotional version of Assessing Neurocognition via Gamified Experimental Logic (2)). The third level of this paradigm is a modified emotional Stroop task (8-10 minute long) where standardized emotionally engaging images (Nencki Affective Picture System (3)) and a text denoting its valence (“Positive” or “Negative”) are presented in either congruent or incongruent configuration (see Figure 1A). Before and after the paradigm there were Rest sessions (alternating eyes-open and closed) of 3 minutes each. The task was presented using Eprime 3.0 stimulus presentation software (Psychology Software Tools, USA). 62-channel EEG and 2-channel ECG were

acquired throughout the session using gel-based active electrode cap connected to 64-channel actiCHamp Plus EEG acquisition system (Brain Products GmbH, Germany) (sampling rate of 1 KHz; 0-500 Hz bandwidth; impedance <50 KOhms). EEG/ECG acquisition and task presentation were time-locked using TTL trigger markers. EEG data was subjected to a standard data pre-processing pipeline in MATLAB using EEGLAB toolbox (ver 2021.0) function. The pre-processed EEG data and the raw ECG data were then taken into Python software, where EEG functional connectivity analysis was done using Frites toolbox (<https://github.com/brainets/frites>) and ECG preprocessing and heart rate variability (HRV) parameter estimation was done using NeuroKit2 toolbox (4). For EEG connectivity, we extracted pair-wise Gaussian Copula Mutual-Information from gamma band filtered epochs of six EEG channels (F3, Fz, F4, P5, Pz and P6) to capture fronto-parietal brain interactions (15 features). For HRV analysis from ECG, we computed time-domain, frequency-domain features and non-linear features to capture short-term cardio-autonomic interactions (62 features). Both EEG and ECG analysis were done on 20s epochs with 15s overlap, corresponding to Rest and Task sessions, giving 11,881 epoch samples with 77 features. This was used to train a Machine Learning (ML) classification model (Random Forest with 100 trees) capturing multivariate interaction between EEG and ECG features that change during ‘cognition-emotion conflict’ task relative to Rest. Training and testing were done from each subject using a 5-fold stratified validation, with f1 accuracy score and feature importance values computed using SHapley Additive exPlanations (SHAP (5)) in each fold, which were averaged to get well-trained subject-specific model outputs (> 95% accuracy). The ML analysis was done using scikit-learn toolbox (<https://github.com/scikit-learn/scikit-learn>). The feature importance values of EEG and ECG features were averaged separately for each subject and statistically compared between the patient and control groups. Welch’s t-test or Man-Whitney test was done with $p < 0.05$ as the threshold.

Results and Discussion: We find that patients with chronic pain have a lower average feature importance value for the EEG connectivity features ($p=0.064$), whereas higher value for ECG HRV features ($p=0.054$), for predicting cognition-emotion conflict task from Rest state (see Figure 1D, E, F and Table 1). This means that during a cognition-emotion conflict scenario, the patients show lesser changes in brain connectivity, and instead show greater changes in cardio-autonomic activity, relative to a baseline state. In terms of behavioural performance, the patients showed significantly lower task accuracy. Thus, taken together, our findings suggest that the inefficiency of patients with chronic pain in cognition-emotion conflict could indeed be due to an underlying imbalance in the interaction between brain activity and physiological activity. Though these are early findings with trend-level differences, the usefulness of the novel approach employed in this study is clear and would motivate further studies in unravelling the mind-body interaction problem in complex disorders like chronic pain and other disorders of consciousness.

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Is there a direct relation between EEG band spectrum and DMN activity in fMRI? - A multivariate exploratory study.

B S Vaishnavi¹, Venugopal Rahul², Reddy Saketh², Sasidharan Arun², Marigowda Vrinda²,
Govindaraj Ramajayam², P N Ravindra², M Kutty Bindu².

¹Department of Cognitive Neuroscience, JSS Academy of Higher Education & Research, Mysuru,
India

²Centre for Consciousness Studies, Department of Neurophysiology, NIMHANS, Bengaluru,
Karnataka, India

Abstract:

Background: EEG and fMRI are extensively employed in neuroscience research, each with its own advantages and limitations. While fMRI offers high spatial resolution but low temporal resolution, EEG provides high temporal resolution but suffers from low spatial resolution. The data from simultaneous acquisition of EEG-fMRI provides an opportunity to capture the distinct advantages of each modality in a single setting. In this paper, we aim to utilise such an EEG-fMRI dataset to explore the relationships between the signals of these two modalities. We are particularly interested in examining the relation between fMRI BOLD signals from Default Mode Network (DMN) regions, a resting state network, and the conventional EEG band spectral data. Through this approach we hoped to clarify whether DMN activity could be reflected by a single band power change in a specific region (like frontal midline theta power increase) or by a multi-band global change in EEG power. Notably, this research question has largely been unanswered.

Methods: We used an EEG-fMRI open dataset of a previous study (1). The initial preprocessing of the EEG data was done (including automated fMRI artefact removal) in EEGLAB toolbox and the fMRI data was done in CONN toolbox (2), both in MATLAB. Then '.mat' files were generated using custom scripts where, the 2.1s EEG epochs and the time-locked fMRI data (ROIs extracted based on default template of CONN toolbox) were extracted and assigned the sleep stage corresponding to the scoring file from the dataset. These files were then imported into Python to do further analysis. The fMRI data of DMN included 4 ROIs (MPFC, PCC, Bilateral parietal lobules), whose mean was taken as the DMN value per time point. From the time-locked EEG data segments (2.1s each), power spectral density was calculated using Welch method (1s window) to obtain one power value per band per channel mapped to the fMRI data. Thus, we obtained a total of 7 frequency bands (delta, theta, alpha beta1, beta2, gamma1, and gamma2) from each of 28 electrodes, giving rise to 196 features per DMN activity time

point. This data was then separated according to sleep stages. Outliers were removed using Isolation Forest algorithm and then subjected to a regression model based on Random Forest algorithm (196 EEG feature trained to predict average DMN value from fMRI). We did a leave-one-out cross validation to compute prediction error (mean square error or MSE) and feature importance values per subject. The importance values for each feature were stored and plotted on topoplots to visualise which of the electrodes and which frequency bands contributed more to the prediction. The average of all the subjects were taken before plotting.

Results: We were able to effectively train the models to predict DMN values using 196 features from EEG data for the wake and sleep stages, evidenced by low average MSE values across subjects (within the range of 0.04 - 0.06) (Table 1). Considering well trained models, we next investigated the feature importance distribution of these models. This would let us know which frequency band and electrode location of EEG data were important in accurately predicting DMN values from simultaneously acquired fMRI data (see Figure 1). Our main finding is that the power in multiple frequency bands helped predict DMN activity in fMRI data, and though most electrode sites were important, the midline sites consistently showed highest values. Furthermore, there was only minimal differences between wake, N1 and N2 stages regarding the abovementioned pattern. N3 stage showed drastic difference, with more peripheral electrode pockets showing high importance. More specifically, midline alpha and gamma power were more predictive of DMN activity in wake stage. Centroparietal delta power and beta2 power were more predictive of DMN activity in N2 stage. Left temporo parietal gama1 power was more predictive of DMN activity in N3 stage.

Discussion: Our results indicate that the DMN activity as determined from fMRI data, corresponds to the EEG band powers of multiple frequency bands (contribute almost equally) especially from midline electrode sites. The results also indicate that the DMN may be acting similarly in rest and light sleep stages but start to slightly deviate in N2 and largely deviate in N3 stage. The fact that a smaller number of subjects reached N2 and N3 stages compared to wake or N1 stages could have contributed to this difference, but the models were still well trained with low MSE values across subjects. A limitation of the feature importance value is that it doesn't inform whether an increase or decrease in power value predicted the DMN activity. Hence for further research, we plan to use SHAP Explainer (a game theory inspired approach to provide explainable feature importance values), though it is computationally very expensive. We could also examine in future whether source-level power values from such low-density EEG data could provide more anatomically localisable patterns. Overall, our approach, though simple, shows good promise in better understanding the relation between EEG parameters (which capture more network-level activity) and fMRI data (which captures more anatomically restricted activity), thereby helping design EEG studies and interpret their results in a better way.

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Classification of Soils in landslide-prone areas according to Vrikshayurveda

Sahil Sankhyan¹, Kv Uday², Varun Dutt¹

¹ IKSMHA Centre, IIT Mandi

² IIT Mandi

Abstract:

Soil classification is essential for its susceptibility to movement and landslides. Ancient Indian texts, such as the Vrikshayurveda, provide valuable knowledge of soil characteristics based on color, smell, texture, and taste. Until now, soils have been classified according to Western approaches for their susceptibility to movements; however, the Indian soil classification perspective by Vrikshayurveda has not been explored. This study aims to extract the Vrikshayurveda-based attributes and classify the soils in landslide-prone areas.

For this study, a questionnaire was prepared on Vrikshayurveda's soil classification. This questionnaire was based on soil properties, like color, texture, taste, smell, and taste of the soil. The questionnaire consisted of 32 questions, and participants rated the questions on a 5-point Likert scale. For the data collection, 60 different landslide-prone locations were selected in the Mandi district of Himachal Pradesh, a district frequented by landslides. Experts for each landslide-prone location filled out the questionnaire. The Cronbach's alpha was 0.773.

Data from the experts was subject to exploratory factor analyses (EFA). The properties of the soils based on Vrikshayurveda were divided into eight different factors. The data sufficiency conditions for factor analysis were met (KMO = 0.732), and a significant Bartlett test ($p < 0.001$).

EFA resulted in three significant components having eigenvalues more than 1.0. These three components meet this criterion: Component 1 (Fine-grained soil), explaining 20.469% of data variance; Component 2 (Coarse-grained soil), accounting for 17.153%; and Component 3 (Earthy Soil), representing 7.2%.

The composition of Fine-grained soil consists of factors such as clay, slit, black color, high water retention, moisture, high fertility, musty smell, fertility, and stickiness. Similarly, the composition of Coarse-grained soil consists of factors like sand, gravel, rocks & debris, yellow color, white color, coarseness, and high water drainage. Earthy soil type consists of an earthy smell, brown color, and low water retention. The main implications of these results suggest that landslides are a result of solids that are either Fine-grained soil, Coarse-grained soil, or Earthy Soil.

Exploring the concept of mind in Ayurveda

Zhillika Pruthi¹, Smitha R Nair¹, Dr. Sanuj Muralidharan¹ and Dr. Saranya S Kumar ¹

¹Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh

Abstract:

Ayurveda is the five thousand years old science in Indian system of Medical Science. It is derived from vedic concepts of health and healing. It is a comprehensive system of body-mind-spirit medicine[1]. Ayurveda explains the word mind as manas and it is considered as one among the 'Tristhuna' (three pillars of life), Acharya Caraka has included manas in adhyatama dravya guna sangraha. Also, indriya is conducive to perceptions only if mana is actively involved. Rashi puru-sha is told as an epitome of atma, buddhi, indriya, manas, indriyaaartha and mano vishyas. Satva is told as the quality of manas and rajas, tamas to be the mano doshas. Satvavajaya is the procedure by which mind is brought under control. Diseases are the manifestations of mano doshas and swastha avastha is told as invariably linked to satva guna. Also, WHO states the definition of health as a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity. Therefore signifying the importance of the mind covering the aspect of mental health.

Effect of Shodhita Shilajatu and Rajata Bhasma on Anxiety – A vitro study

Suchitra S Patil¹, Bb Joshi², Pradeep Agnihotri²

¹SVYASA

²AMV Hubli

Abstract:

Background: Shilajatu and Rajata are important mineral drugs having medhya property. There are studies available on effect of shilajatu on diabetes, obesity and anxiety also, Rajata bhasma have proven to increase the memory, concentration. The main objective of the study was to observe the effect of Shodhita Shilajatu and Rajata Bhasma on anxiety in mice. **METHODS:** Shodhana of Shilajatu was carried out by suryatapi method/, Shodhana of Rajata was carried out according to classical texts by using taila, takra, gomutra, kanji, kulattha kwatha. Rajata Bhasma was prepared using Kumari swarasa Bhavana as per Ayurveda Prakasha. Organoleptic characteristics, ash value analysis, SEM analysis of Rajata and Shilajatu were carried out according to standards. Anti Anxiety activity was analyzed by using light and dark test, open and closed arm activity test on four group of mice.

RESULTS: Both Rajata and Shilajatu group rats have showed highly spent more time in light chamber 105.3 ± 6.296 , 114.8 ± 6.215 respectively and open space against control group with Diazepam (94.0 ± 2.39) and standard groups (30.5 ± 1.50) $p < 0.001$ / Locomotor activity was more in Shilajatu and Rajata Bhasma groups (429.2 ± 3.73 , 437.7 ± 6.31) when compared to Normal saline and Diazepam group (289.3 ± 5.07 , 374.7 ± 4.83)

CONCLUSION: Rajata Bhasma and shuddha Shilajatu improved significantly the time spent in light chamber and locomotor activity when compared to normal saline and Diazepam groups of mice suggesting the good Anti Anxiety effect.

Proposal of a personality framework based on Ayurveda and Yoga for use in pre primary education in Indian context

Rohit Pandey Pandey¹ , Nirjara Sethia² and Jyoti Kumar¹

¹IIT Delhi

²Delhi University

Abstract:

According to the Ayurveda, psychosomatic composition of individuals consists of elements like Tridosha, Saptadhatu, Saptaupdhatu, Panchabhuta, Panchakosha etc. The tridoshas are claimed to influence human personality as each dosha exhibits specific qualities to an individual, leading to observable differences in temperaments. Western psychology has studied individual temperaments as building blocks of personality. In the context of education under NEP 2020, there has been focus on social emotional development of children during pre primary phase. This paper argues that social emotional development may be influenced by the personality of the child acquired by birth in the form of the tridoshas. This paper first presents a comparison of the Tridosha model with the personality trait model of modern psychology and then proposes a framework to be used during early childhood education. Finally, it proposes curricular and pedagogical interventions using principles of yoga for improvement in academic goals as prescribed in NEP 2020 and NCF 2022 for early childhood education in the Indian context.

A combined effect of shirodhara and tikatak ksheer basti in the management of parkinson's disease w.s.r. to kampvaat"

Dr Rajesh Kumar¹.

¹Rama University Kanpur Uttar Pradesh

Abstract:

Neurological disorder is the Speedily spreading disorder in all over the world. Parkinson's disease is one of the them characterised by rest tremor, stiffness , gait dysfunction with postural instability. The prevalence of Parkinson's disease according to WHO has doubled in the past 25 year. In 2019, 8.5 million individuals are living with Parkinson's disease globally. Disability and death due to the Parkinson's disease are increasing faster than any other neurological disorder. In Ayurveda classics Kampvaat is the condition which closely resembles with Parkinson's disease. According to Acharya Charak endogenous disease caused by single vaat dosha described in 80 types of vaataj nanatmaj vikara named as VEPATHU means Shaking for trembling. According to Madhav Nidan tremors in all over the body and specific organ due to the aggravation of vata called Kampvaat. longer use of modern medicine used in treatment of the Parkinson's disease having more side effects like excessive day time sleepiness, hallucinations, delusions, confusion etc. Shirodhara is the one of the Panchakarma procedure which act on the cerebral system helps in the relaxing the nervous system and balancing the Prana Vayu around the head. Basti is the one of panchakarma Procedure describe as "Ardha Chikitsa" by Acharya charak for all type of Vaat Roga. This paper is being presented to state the effect of combine therapy of Shirodhara and swa-anubhoot Tiktak ksheer basti in the management of Parkinson's disease w.s.r. to Kamvaat.

Effects of Relaxed and Stressful Mental States on the Heart Rate Variability Parameters

Kulbhushan Chand¹, Shilpa Chandra², Varun Dutt²

¹IIT Mandi iHub and HCI Foundation, Indian Institute of Technology Mandi, HP, India

²Indian Knowledge System and Mental Health Applications Centre, Indian Institute of Technology Mandi, Kamand, HP, India

Abstract:

Heart rate variability (HRV) is a reliable metric for gauging the balance between relaxation and stress within the human body, offering insights into autonomic nervous system regulation. A significant component of HRV is modulated by the vagus nerve, the principal nerve of the parasympathetic system. Its fluctuations provide a valuable way to assess an individual's physiological and emotional well-being. While considerable evidence demonstrates that HRV parameters improve during mental relaxation and decrease during cognitive workload tasks, there is limited research that provides a comprehensive comparison between these states, specifically with regard to vagal activity. This study aims to bridge this gap, offering a detailed comparison of HRV metrics, including those reflective of vagal (parasympathetic) tone, during distinct mental states, thereby contributing valuable data to this critical aspect of autonomic physiology research. Methodology: A within-group counterbalanced randomized controlled trial with N=44 participants was carried out for two interventions: Relaxation and Stress. In the relaxation group, participants underwent a 5 min of paced breathing task by following a visual cue to maintain their breathing pace at 10 breaths per minute, a practice known to enhance vagal activity. In the stress group, participants underwent a 5 min of time-bound mental arithmetic task, where they had to answer a series of progressively difficult arithmetic questions quickly, a condition expected to reduce vagal activity. Heart rate (HR) and RR beats were recorded and pre-processed before the extraction of HRV parameters. Results: Out of various HRV parameters, ten were found to differ significantly between the two interventions. Compared to the literature, all the significant parameters exhibit the improving and degrading tendency of HRV parameters in the relaxed and stressed states, respectively. During stress, a reduction in the SDNN, Standard deviation in HR, RMSSD, RR triangular index, TINN, Deceleration capacity (reflective of vagal modulation), and increase in the SNS Index, Stress index, Minimum HR, and respiration rate were seen. All these parameters show a rebound during the relaxation intervention. Large effect sizes were obtained for all the significant parameters, except for a moderate effect for Deceleration capacity and a small effect for RMSSD. Conclusion: HRV parameters significantly vary in mentally relaxed and stressful states. The computed parameters degrade

(become lower or higher) during the stressful state, which indicates the sympathetic dominance and reduced vagal (parasympathetic) tone as mediated by the vagus nerve, and rebounds to significantly different values during relaxation, indicating a resurgence of parasympathetic (vagal) activity and a relaxation response. The large obtained effect sizes assure the use of HRV, and by extension vagal tone, as a reliable indicator to assess a person's relaxed and stressed mental state. This research highlights the nuanced and significant changes in HRV parameters between distinct mental states, thereby bolstering the case for using HRV as a precise tool in mental health assessment and intervention planning, with a special emphasis on the role of the vagus nerve. Furthermore, the relaxed and stress interventions in the study can be used as baseline measurement interventions for comparative studies in similar areas, paving the way for more targeted and effective mental health strategies.

The Yoga of Non-Separation: Consciousness and the Relational Whole

Ian Whicher¹.

¹University of Manitoba

Abstract:

While Yoga today in its most popular expressions is primarily associated with a physical culture for which it is well known, the meaning and value of Yoga lies in its deeper dimension, in the domain of mind, consciousness, and self-transformation leading to spiritual liberation or freedom. The potential for an embodied, relational freedom whereby consciousness is wholistically aligned in our day to day lives, is either overlooked or left unexplored. For example, Yoga as classically formulated in Patañjali's Yoga-Sūtra, has far too often been misconstrued as leading to a freedom from the world, emphasizing renunciation, asceticism, disengagement, and transcendence of the body, mind and world. Interpretations of Yoga that adhere to an absolute separation of consciousness or spirit from manifestation or formed existence, implying a final unworkable dualism between liberated spiritual identity and life-in-the-world, amount to an impoverishment of our life potential, that is of the possibilities for an embodied, relational life. Yet, from another perspective, freedom can be understood as being immanently present in and for the world, thus supporting a life-affirming approach that challenges us to an enriched, relational humanity allowing for evolution, development and innovation through which life progresses and the world is made a better place. Through a deeper, mature and adept philosophical and experiential knowing, and drawing from and updating the classical tradition, we will explore how Yoga can culminate in a balanced integration of life that incorporates a clarity of awareness with the integrity of being and action. Yoga manifests as the very abiding as and sharing of our being or power of consciousness, in which the non-separation of self and world, experiencer and experienced, knower and known, is uncovered and lived as our authentic nature.

A Yogic Neuroscience Framework of Aesthetic Experiences

Eesha Eesha¹, Greeshma Sharma², Jyoti Kumar²

¹Indian Institute of Science Bangalore

²Indian Institute of Technology Delhi

Abstract:

Aesthetic experience encompasses a unique form of consciousness that transcends cognition and emotion, evoking a sense of admiration for beauty. However, existing cognitive and emotional theories fall short in fully explaining this phenomenon. This paper highlights the potential of Yogic Neuroscience, a framework that integrates theories from the ancient Indian Vedas, to provide insights into the perspectives that modern science struggles to support. By incorporating these theories, particularly those found in the Taittiriya Upanishad and Saundarya Lahari, into the modern education, novel avenues for understanding aesthetic experience as an awakened consciousness can be explored. These ancient texts shed light on the interconnectedness of aesthetics, consciousness, and the human experience of beauty. The integration of such theories into education facilitates a deeper comprehension of aesthetic experiences, unveiling the profound connections between consciousness and artistic appreciation. By embracing these insights, a more holistic understanding of aesthetics can be achieved, allowing for a comprehensive exploration of the depths of human perception and the aesthetic realm.

Enhanced delta & theta frequency in Yoga-based breathing-preliminary investigation findings

Prerana Reddy ¹, Ramajayam Govindaraj ², Arun Sasidharan ², Ravindra P Nagendra ² Bindu M Kutty

¹ JSS Institute of Higher Education & Research, Mysore

² Centre for Consciousness Studies (CCS), Dept of Neurophysiology, NIMHANS, Bengaluru

Abstract:

Yoga based-breathing technique involves regulation of inspiration, expiration and the pause between them. Yoga and modern science reports two-way relation between breath & mind. Despite evidence for the symbiotic relation between breath and mind, the intricate relation between breath and brain oscillations are least explored in human studies. This study explored brain oscillatory changes during 1:2 breathing (Yoga based slow breathing) and kapalbhathi (Yoga based fast breathing). Seven participants (2 males) with mean age 28years underwent experiment protocol consisting 2minutes of normal breathing (NB1) - - 15 cycles of 1:2 breathing (RB)---2 minutes of normal breathing (NB2) - - 1 minute of kapalbhathi (KB)- - 2 minutes of normal breathing (NB3). In regulated breathing (1:2 breathing) exhalation was twice that of inhalation and in kapalbhathi, exhalation was done at 1 stroke per second. Data was acquired with a 64-channel EEG recorder. Power spectral density (PSD) values for RB and KB were compared with NB. There was significant increase in delta (NB1 vs KB- $W=0$; $P=0.03$ & NB3 vs KB- $W=21$; $P=0.03$) and theta power (NB1 vs KB- $W=0$; $P=0.03$ & NB3 vs KB- $W=21$; $P=0.03$) during kapalbhathi compared to normal breathing; significant increase in delta power post RB (NB2 vs RB- $W=0$; $P=0.03$). Our preliminary study findings demonstrated enhanced delta and theta power during kapalbhathi and enhanced delta power post RB (1:2 breathing). This might explain the experience of alert calmness in pranayama practice. Findings have neuropsychiatric implications, which needs to be confirmed in controlled trials in larger sample.

Samatvam, arogyam: mining practises from yoga, buddhism; Applying it (test, identify, treat, prevent tragedy) to improve management of mental health in students

Sumantran Ray ¹

¹ INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

Abstract:

Background: Mental health issues have become a major concern during, and after the Covid 19 pandemic lockdown period. In India rates of depression, and, tragically, suicides are reported to be increasing with students, house-wives, daily wage labourers constituting the main vulnerable occupational groups (NCRB data). The suicide rates in premier educational institutes like IIT, IIM, NIT, where according to the education minister about 122 students have reportedly committed suicide in past 5 years, is wake-up call to re-examine mental health policy. The magnitude of the problem can be gauged by the statistics- the suicide rate in India is 10.6 per 100,000, close to the global average of 11.6, amounting in absolute terms to 133 623 deaths registered as suicides (Armstrong G., Vijayakumar L., 2018). This raises the question of the current efficacy of mainstream Psychiatry, which focuses mainly on neuro-psycho-pharmacology, with the Biomedical model of mental “illness” implicit in the background, and the big pharma industry interests in the foreground (Deacon, 2013). In this paper the primary focus will be on critical examination of limitations of mainstream Psychiatry in treating depressive disorders, and the quest for improving management methods by augmentation with practices from Indian Knowledge Systems like Yoga, Buddhism. Furthermore, medical Neuro-Psychiatry has had limited success with effectively treating depressive disorders (Moncrieff, Cooper, Stockman, Amendola et al. 2022), with about 45% of under treatment patients not responding with remission. This challenging situation calls for serious rethink, research to restructure public mental health policy, and practice. Instead of relying only on Psychiatric medication, which reportedly have small ***antidepressant effect size above placebo controlled group effects (Kirsch, et al., Khan, Fawcett, Lichtenberg, Kirsch et al, 2012), and also involve treatment resistant depression, we emphasize on leveraging health solutions from Indian Knowledge Traditions with focus on Yoga system, and Buddhism (Vipassana, Mindfulness meditation). The principle of accepting more responsibility for one’s own health, by choosing healthy life habits instead of depending on medicines alone, regulating one’s beliefs and behaviors informed by the time tested insights of Yoga, Buddhism, Meditative practices, is emphasized. [Applying IT (Test, Identify, Treat, Prevent Tragedy : The large number of

students make individual attention , and monitoring difficult , and necessitates standardized computerized automated methodology to identify at-risk students. The mental health act 2017, with emphasis on informed consent, respect for privacy needs to be adhered to while giving intervention to the at-risk students]

Aims , & Objectives:

To critically examine mainstream Psychiatric practise , often based on the Biomedical model, specifically with respect to treatment of depression. To examine Yoga System, and Buddhist Philosophy practise, in the light of scientific framework to select treatment modalities which can inform public policy for mental health. The emphasis is on prevention of depressive disorder, and promotion of mental-health while reducing long-term dependence on medication.

To specifically analyze cognitive-neural mechanisms underlying depression (cognitive distortions, rumination, experiential fusion, etc.) and how they can be fruitfully addressed by application of yogasana, and meditation techniques. Specifically , this paper is part of scientific program to mine those practises from Yoga, and Buddhism which are consistent with scientific knowledge, which can be leveraged to manage the scourge of treatment resistant depression. Therefore we seek scientific analysis of the mechanisms underlying beneficial Psychological effects of exercise, Yoga, meditation to develop methods for self regulation of mood states, which is required for the people who are not fortunate enough to experience remission of depressive symptoms. Applying IT (Test, Identify, Treat, Prevent Tragedy: To propose in outline, automated system for mental health care geared towards early identification of vulnerable , at-risk people, for early treatment. The initial outline proposes utilization of computer software based Psychological testing, for periodic data generation, data analytic algorithms to identify vulnerable people, and early treatment for prevention of tragedies like drop-out from educational system, or suicides. This has become crucially important given the high rates of student suicides in students in premier institutes (2023 has already seen suicides in IIT Bombay, IIT Madras(4 suicides))

Methodology: Combine philosophical analysis of classical texts (Patanjali Yoga sutra, Hatha Yoga Pradipika, Satipatthana sutta) with scientific findings from Cognitive Science, Cognitive Neuroscience to elucidate the possible mechanisms underlying the effects of Yoga, and meditative practises.

In terms of philosophic , epistemic framework, non-reductionist Complex Systems (Embodied) Dynamics framework is adopted which takes into account the role of the body/mind interacting with the micro-environment, in addition to that of the brain. Although the Mind- Body problem is not explicitly examined , the simplistic reduction of mental states to brain states , which may be followed by some adherents of the Biomedical model, is considered to be useful to a point, but incomplete.

Perspectives from philosophy of Cognitive Science, namely Embodied, Embedded, Extended, Enactive Cognition is utilized to rationalize, and motivate causal connections, and possible mechanisms underlying effectiveness of some therapeutic practice. .

We emphasize the physiological, and neural mechanisms, as well as the neuro-cognitive mechanisms underlying both pathological processes like rumination, and healthy practice like meditation. Specifically the neural processes mediating the effects of Yoga, Pranayama, Dhyana (meditation) is examined. We discuss the effects of yogasana on the noradrenergic system, and of Pranayama (top-down controlled breathing) on the Autonomic Nervous System.

To do a scientific analysis we examine the brain networks, and neuro-modulatory systems (e.g. muscles, myokines) involved in Mind-wandering, effects of Hatha Yoga, effects of Mindfulness meditation. Specifically, In case of Mind-wandering the Default Mode Network, and it's anti-correlation to Central Executive Network (CEN) is analyzed. Applying IT (Test, Identify, Treat, Prevent Tragedy) : To do literature review, and feasibility study to develop outline of computerized system to acquire mental health data (with informed consent), utilize AI, ML algorithm (or team of Psychologists) to identify at risk people, who can opt , (depending on details of the case) , for some combination of Neuro-Psychiatric treatment, Computer based Psychotherapy, Psychotherapy & Counseling, Living & Coping Skills Training. Observing the increase in rates of substance abuse, psychiatric disorders, suicides, it is proposed that de-stigmatization, regular awareness drives, regular psychological testing, treatment of at risk students, and compulsory teaching of living, and coping skills be implemented)]

Results:

Yoga Ashtangika Marga, Yoga Postures: Yoga Postures for Altering Brain Physiology To Improve Cognition:

“Yoga Citta Vrtti Nirodhah” - Yoga is the path to cessation of mental fluctuations. The sage Patanjali, one of the great innovators in the long tradition of Yoga suggested an 8 limbed path for health, and spiritual development (Patanjali Yoga Sutra). Being specifically concerned with utilizing Yoga for mental health, it is proposed that observance of yama, niyama, yogasana, pranayama are effective in managing depression. The practical side of Hatha Yoga is consistent with the perspective of Embodied Cognition which posits a close link between bodily presence and cognition. Recent research has found that vigorous physical exertion results in stimulation of the neuromodulator noradrenaline in the Noradrenergic system in the brain which is associated with improved mood, attention working memory (Sara S.J., 2009). Recent research has discovered that a class of compounds called ‘myokines’ are released by muscles which can cross the blood-brain barrier, and elevate mood by increasing hope (Hoffmann, Weigert, 2017). To build strength , it is desirable that Hatha Yoga practices are suitably modified according to needs, and age to students in schools, and colleges.

Further research is needed to elucidate whether certain Yogasanas have comparatively more effect on mood elevating mechanisms.

Meditation, Buddhist Samatha, Vipassana Bhavana & Satipatthana Sutta , Meta-Cognition & Cognitive Control

Treatment resistant depression, and relapse of depressive episodes are major concerns for Psychiatry. The meditation technique taught by the Buddha, called Vipassana, related to the western adaptation Mindfulness meditation , helps in cultivation of Meta-Awareness. Numerous researchers have found that cultivation of Meta-awareness and associated attentional characteristics like defusion, de-reification helps in coping with negative automatic thoughts which are cognitive symptoms of depression (Teasdale, Segal, Williams, Ridgeway, Soulsby, Lau,(2000). The practise of mindfulness, also called “Sakshi Bhava” in Indic tradition has been found to be so beneficial that many of the new generation psychotherapies like Dialectical Behavior Therapy (Linehan M., 2005), Acceptance and Commitment Therapy (Hayes S., 2004) have adopted mindfulness as a core self awareness, and cognitive control skill. To elucidate the physiological bases of the effects of controlled breathing (pranayama), and meditation we consider the effect of slow rhythmic breathing on the vagus nerve which is pro-parasympathetic, and helps in calming down.

D. Applying IT (Test, Identify, Treat, Prevent Tragedy) : Previous research has shown that it is possible to apply AI, ML algorithms like random forest classifier on input data from mental health questionnaire to classify people at risk for suicide, and help them. A study published in Nature found that complex interaction between Socio-Economic factors, Psycho-Social stressors (child abuse, bullying) result in psychological distress, with self esteem, trait anxiety, depression symptoms, 12 month suicidal ideation having maximum predictive power (Macalli, Navarro, Orri, Tournier, Thiébaut, Côté & Tzourio (2021). To manage a large student body,in which individual interviews are difficult, it is proposed that empirical data from multiple computerized sources- psychological tests, class attendance etc be collected periodically , and analyzed using predictive algorithms. The students at risk for suicide are to be treated

Conclusions and implications:

The serious problem of increasing rates of suicides require a re-evaluation, reconstruction of mental health care practises to increase efficiency. Instead of becoming solely dependent on psycho-active medicines whose long-term effects are unknown (El Mallakh et al, 2011), a holistic Complex Adaptive Systems framework is sought to be applied with focus on progressive research on discovering various causal pathways, and management methods which can contribute to improved mental health.Regular data acquisition, data analysis to identify at-risk students for early treatment to prevent tragedies like suicides may be useful.

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Emotional Reactivity Patterns Disturbances in Psychogenic Nonepileptic Seizures: A task fMRI

Meghana B.K¹, Kenchaiah Raghavendra¹, Karthik Kulanthaivelu² and Krishna Prasad³

¹Department of Neurology, NIMHANS, Hosur Road, Bangalore. India

²Department of Neuroimaging and Interventional Radiology, NIMHANS, Hosur Road, Bangalore

³Department of psychiatry, NIMHANS, Hosur Road, Bangalore, India

Abstract:

Background: Functional neurological disorders (FNDs) are thought to be influenced by dysfunction in the emotional process. Studies on emotion processing are necessary to understand the causes of psychogenic non-epileptic seizures. Epilepsy-like paroxysmal actions resemble seizures, although they lack the molecular basis underlying epileptiform brain activity. Objective: To evaluate and compare the pattern of activation-associated psychophysiological score between case cohorts on emotional face processing by using task-functional MRI.

Method: In this study, 25 patients with PNES (aged 18-43 years) and 25 Healthy controls were prospectively recruited to select from those who will not have any clinical contraindication to undergo MRI acquisition in the 3-T scanner (Philips, Gyroscan Best, The Netherlands). Our protocol includes a T1-weighted spin echo sequence and Task-Fmri. Evaluating the brain pattern by task, all participants were instructed to relax and not think about particular events during the task. During the 5-minute emotional faces task[(EFT)(happy/sad/fearful/angry/surprised/disgusting)], participants were presented with target images (center top) and two probe images (bottom) left and right) in a triangular format, and instructed to match the target image to probe the same emotion, face, and object by pressing either the match or no match button using the right hand only. Visual analysis of images was performed by experienced epileptologists as well as radiologists. We also collected reported data on psychological distress and symptoms of depression, anxiety as well and stress [via the Depression Anxiety Stress Scale (DASS-21)]. Further Task fMRI data were pre-processed using Statistical Parametric Mapping (SPM12) in Matlab. Results were categorized into (Match vs no match, and emotion vs fix) and correlated with DASS21 scores using the GLM model.

Results: To investigate the task experiment conditions (Match vs No match, Emotions vs Baseline) sample t- t-tests were conducted by using SPM software. Revealed a significant individual attribution pattern for match vs. no-match processing mainly involved in emotion regulation and visual circuits in various brain regions including the parietooccipital lobe(precuneus, and calcarine) and the posterior regions increased functional correlation in PNES, and frontal mild areas were found to decreased in

HC. On the other hand, emotions face vs baseline conditions seem associated with activation in the motor-frontal cortex (Superior Frontal Gyrus). Compared to HC, the activity of several brain regions including those connected to emotion regulation and motor control circuits, increased. Sections of the cerebellum, occipital_mid, and parietal lingual areas yielded more significance in between the groups.

Conclusion: Results of task analysis are preliminary given evidence that patients with PNES exhibit altered facial emotion alterations. This finding points to a potential key difference in facial emotion processing that may be indicative of altered neural circuitry which can be used in emotion processing and affects the emergence and maintenance of PNES.

An Exploratory Analysis of Traditional Meditational Practices: Insights from Psychometric Data

Navya Sonal Agarwal¹, Kapil Gupta², G.R. Sinha²

¹ Kalinga Institute of Industrial Technology Bhubaneswar, 751024, India

² International Institute of Information Technology, Bangalore, 560100, Karnataka, India

Abstract:

Meditation practices involve training the mind to focus and redirect thoughts, primarily to increase awareness, relaxation, and inner peace. In the present era, traditional meditation techniques are rejuvenated by Yoga gurus. Assessing the precise impact of meditation on individuals is a difficult task due to their unique postures and styles. The goal of this study is to compare the impact of three traditional meditation practices, namely, Himalayan Yoga (HP), Isha Shoonya (SNY), and Vipassana (VIP), during a meditative (MED) and instructed mind-wandering (IMW) block with a control (CTR) group. In this work, fourteen psychometric scores obtained from 27 HP, 20 SNY, 20 VIP practitioners, and 32 healthy subjects from the CTR group have been considered to evaluate the impact of meditation. The min-max normalization technique has been employed to eliminate feature dominance. Statistical exploratory data analysis (EDA) has been used to draw the heat map of pre-processed scores to segregate the features into four categories, compute, and plot the mean value for comparing one feature among all four groups, and all features across all the groups. Additionally, we have compared the interplay between MED and IMW blocks. The obtained results depict a 30.8% increase in the focus level of SNY practitioners when they performed MED after IMW, whereas contrasting results are shown by HP and VIP meditators. The categorical analysis represented the average highest concentration and uneasiness levels of 0.639 and 0.736, respectively, in HP, with higher distraction (0.550), higher comfort (0.688), and lower uneasiness (0.198) in SNY practitioners.

Multivariate EEG pattern during Dreaming shows higher non-linear feature contribution and inter-individual variability in a high-density PSG data.

Zubair Adla¹, Kumar Gulshan¹, Kuriakose Sruthi¹, Naaz Safoora¹, Venugopal Rahul¹, Marigowda Vrinda¹, Sasidharan Arun¹, P N Ravindra¹, M Kuty Bindu¹.

¹Centre for Consciousness Studies, Department of Neurophysiology, NIMHANS, Bengaluru, India.

Abstract:

Background: The phenomenon of diminished consciousness during slow wave sleep, despite the presence of neuronal activity in the thalamocortical system, has been identified. Contrariwise, in the other stages of sleep, individuals who are awakened often report experiencing dreams, particularly during REM sleep, although not exclusively. The study of sleep and dreams necessitates the use of subjective reports as opposed to direct observation, as the latter is deemed unreliable, often imprecise, and challenging to control by exposure to external stimuli. As a solution to get more empirical evidence on dream phenomena, the use of brain waves to decode dreams has become popular. Studies have been trying to associate transient phasic activities such as eye movements, PGO waves, and EEG power changes in specific frequency bands with dreaming, to identify EEG markers indicative of the dreaming state in subjects. One such prominent finding is that dreams are associated with local decrease in low-frequency activity in the posterior cortical regions. But the electrical activity of a brain measured by EEG exhibits complex behaviour with nonlinear dynamic properties and sleep and dreaming are global brain phenomena. Considering this, employing a univariate and region-specific strategy may not be the most optimal method for determining EEG markers of dreaming.

In this work, we focus on examining multivariate characteristics derived from EEG data (conventional and nonconventional features) across scalp regions to identify potential indicators for different dream situations.

Methods: This study used EEG data of 22 subjects from an ongoing Ph.D. project at NIMHANS. The project required subjects to undergo three whole nights of polysomnography (PSG) recordings. On day one, the participants had to sleep a whole night without any interventions. On day two, they were woken up randomly at different sleep stages and cycles, and their dream reports were taken after an awakening alarm of 6 seconds. On day three, the participants were given affective sounds during different sleep stages and cycles, followed by an alarm tone after a gap of 10 seconds. Dream reports were collected after the alarm on day two and day three. The subject was awakened throughout the night using a 6-second awakening alarm and was asked to report whether they had been dreaming (Dream) or not (No

dream) just before the alarm. If they were dreaming, then they also need to report if they can recall the dream (dream recall) or not (dream no recall). The EEG brain activity of the participants was acquired using 62 channels as per the 10-10 international electrode placement system. Electrooculogram and electromyogram electrodes were also placed. For the current work, we used data from day two.

The analysis is done mostly using the MNE toolbox in python software. The 62 channel EEG data of 22 subjects are pre-processed and epoched around the alarm event markers. The epochs consist of 15 seconds before the awakening alarm corresponding to different dream conditions (dream no recall, dream recall, and no dream) and different sleep stages (NREM and REM). From the epochs multiple features are extracted per channel. The features included: relative band powers from conventional PSD, relative band power in periodic and aperiodic oscillations separated (IRASA & FOOOF features), and nonlinear features (entropy such as permutation entropy, SVD entropy, sample entropy, and fractal dimensions such as DFA, Petrosian, Katz, Higuchi, and Lempel–Ziv).

The channel features were then used to train a random forest classifier model into two classes (dream and no dream), separately for NREM and REM. We employed a leave-one-out cross validation to determine the accuracy (F1 score) and feature importance. This also gave us individual level accuracies and feature importance using model trained on all other subjects, at each electrode site.

Results: The feature importance for the classification of dream vs no dream showed that the features that were majorly contributing to the classification were mostly non-linear features (like Higuchi and DFA) across all subjects, in both REM and NREM stages (Figure 1). We also observed drastic variation in the overall accuracy scores and its scalp site distribution across the subjects, with some showing accuracy as high as 96.5% and other as low as 47.2% (Figure 2). We also observed that the areas that showed higher accuracy for the classification were different for dream reports of REM and that of NREM.

Discussion: Our results indicate that the dream and no dream EEG characteristics show multivariate patterns, contributed highly from multiple non-linear features and high frequency oscillatory features. Despite this commonality, the huge inter-individual variability in classification accuracy and scalp distribution suggests that there is no general multivariate EEG pattern for dream and no dream state across individuals. Instead, EEG pattern for dreaming may show individual specificity. This could be because dream experience and content of everyone is also different. Depending on their thoughts and general circuitry, the networks involved could be completely different from person to person, hence looking for a common EEG marker would not be the proper approach, but instead, further studies should look for more multivariate EEG markers that are individual-specific. We also observed difference in pattern between REM and NREM. This is in line with the literature that states how the dream content varies in case of NREM dreams and REM dreams.

Conclusion: EEG pattern detection of dreaming requires a multivariate approach with a prominent contribution by non-linear features outdoing the conventional spectral features. The pattern is also spread across different scalp/brain regions rather than isolated brain regions. Having shown how the dream markers could be individualistic, bringing in the emotional and contextual characteristics of the dreams could pave the way to find better markers.

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Analytical and Creative Intelligence: A Comparative Study on Perceived Cognitive Load

Ashfaq Jafar Kp¹, Shabnam Unknown²

¹Research Scholar, National Institute of Technology, Kurukshetra, Haryana, India

²Assistant Professor, National Institute of Technology, Kurukshetra, Haryana, India

Abstract:

Introduction: Cognitive load plays an essential role in everyday human activities. It is inevitably connected with academic settings, work settings etc. in which people's cognitive processes and their contribution is counted. Sweller introduced the concept of cognitive load theory (Sweller, 1988). Cognitive load is the capacity of working memory to handle information simultaneously. According to his theory, working memory has a finite capacity, and as such, educational approaches should be mindful not to overrun it with extraneous tasks that do not directly contribute to the learning process (Sweller, 1988). Creativity holds significant value within the field of human psychology, as it contributes to the formation of fresh and innovative ideas for social interaction and communication (Fink & Benedek, 2012; Smith, 1995). In an attempt to investigate the connection between cognitive load and creativity in the process of conceptual design, Sun et al. (2012) conducted a study. The findings of their research indicated that cognitive load was more closely associated with the production of novel ideas. Moreover, the study demonstrated that individuals with more experience in the field exhibited higher levels of cognitive efficiency compared to novices. Papuc et al. (2017) employed objective measurement techniques to assess cognitive load during creative tasks and discovered that the use of relaxation music could reduce the cognitive load induced by these tasks. In a separate study conducted by Gupta et al. (2020) concerning cognitive load during mathematical problem-solving, a significant positive correlation between the types of cognitive load was identified. This correlation suggested that a person's interest in the instructional domain plays a crucial role in influencing the germane cognitive load.

Objective: The objective of this study is to examine and compare the cognitive load perceived by individuals while engaging in both analytical and creative tasks. The term perceived cognitive load describes how much mental work it takes to complete a certain task or cognitive activity from the perspective of the person who is doing the task. By considering how people perceive their own cognitive load, researchers and practitioners can create tasks, instructional materials, and learning environments that minimize the cognitive load, promote effective learning, and task performance, and improve people's overall cognitive experiences and productivity.

Method: The study was conducted on 103 graduate and postgraduate students who were asked to complete the analytical intelligence and creative intelligence tasks. Test of analytical ability and creative ability are used from Sternberg Triarchic Intelligence Test (Sternberg, 1993) which consists of 24 items. Out of the total number of items, 12 items were used as the tasks for the present study. After finishing each task, participants completed the NASA TLX ratings which serves as a comprehensive tool for evaluating cognitive load and comprises 21 items that assess various dimensions, including physical demand, temporal demand, mental demand, performance, effort, and frustration. In this study, at first part of the study, participants took analytical tasks and provided ratings on the NASA TLX questionnaire. In the subsequent phase, they were assigned creative tasks, followed by another round of rating using the NASA TLX questionnaire. The collected data were subjected to statistical analysis using SPSS Statistics (version 25). Pearson's correlation and independent sample t-test were employed for data analysis.

Result & Discussion: The result of this study revealed a significant difference in the perceived cognitive load between the analytical and creative ability tasks. Table 1. Descriptive statistics and t-test of cognitive load in analytical and creative ability tasks. Mean Std. Deviation t Sig. (2-tailed) Cognitive Load in Analytic Task 60.61 15.35 40.05 .000 Cognitive Load in Creative Task 61.57 15.91 39.26 .000

According to Table 1, the mean of cognitive load in analytic tasks (60.61) is lesser than the mean of cognitive load in creative tasks (61.57), which means the cognitive load is higher in creative ability tasks than in analytic ability tasks. t-test was used to analyze the significant difference between cognitive load in analytic ($t=40.05$, $p<0.05$) and creative tasks ($t=39.26$, $p<0.05$). This means that there was a significant difference between the cognitive load of analytic and creative tasks.

Table 2. Correlation analysis between analytical ability, creative ability, and cognitive loads. Analytical Ability Cognitive Load in Analytic Ability Cognitive Load in Creative Ability Creative Ability Analytical Ability Pearson Correlation 1 .150 .115 .536** Sig. (2-tailed) .131 .249 .000 Cognitive Load in Analytic Ability Pearson Correlation .150 1 .696** .109 Sig. (2-tailed) .131 .000 .275 **. Correlation is significant at the 0.01 level (2-tailed).

Based on the findings presented in Table 2, a significant statistical correlation exists between the scores obtained for analytical ability and creative ability. Furthermore, a positive correlation is observed between the cognitive load experienced during analytical tasks and the cognitive load experienced during creative tasks.

Since the aim of the study was to compare the cognitive load in the analytical ability task and the creative ability task, the results indicated that there is a significant difference between the perceived cognitive load of analytical and creative ability tasks. This suggests that these two types of cognitive

activities impose distinct cognitive demands on individuals. This finding aligns with previous research highlighting the unique cognitive processes involved in analytical and creative intelligence.

Conclusion: The findings of this study support the existence of a significant difference in the perceived cognitive load between the analytical and creative ability tasks. These findings contribute to our understanding of cognitive processes in different task contexts and can inform the development of strategies to optimize task performance and cognitive resource allocation.

Keywords: Cognitive Load, Analytical Intelligence, Creative Intelligence

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Targeting ongoing neural oscillations and aperiodic activity through tACS: Unravelling frequency specific modulation and nonlinear interactions

Rahul Venugopal¹, Arun Sasidharan¹, Ramajayam G¹, Ravindra P.N¹, Nithin Nagaraj², John P John³,
Bindu M Kuty⁴

¹Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

²Consciousness Study Program, NIAS), Kaviraj Udupa (Dept. of Neurophysiology, NIMHANS

³Dept. of Psychiatry, NIMHANS

⁴Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

Abstract:

Transcranial alternating current stimulation (tACS) is a non-invasive neuromodulatory technique which delivers time varying weak electric currents onto specific scalp regions to generate low intensity electric fields inside the brain. These exogenously produced fields have the potential to influence oscillatory dynamics, synaptic plasticity, and bias the interspike intervals. Given the close relationship between cognition and oscillatory dynamics, tACS provides a special technique to target particular brain oscillations and influence cognitive behaviours both in typical and atypical populations. In our study, we investigated the temporal effects of low and high frequency tACS as well as breathwatching on the aperiodic and oscillatory spectral characteristics of resting EEG

A Critical Inquiry into Higher-Order Consciousness

Vijaya Runchu Choudhary¹

¹IIT Bombay

Abstract:

In recent time, in philosophy of mind, there is a discourse on Higher-order Consciousness. Some of the eminent philosophers are David Armstrong, William Lycan, David have Rosenthal and Peter Carruthers have argued that higher-order mental states play a crucial role in determining the contents of conscious experience, according to higher-order theories of consciousness, a mental state is conscious when it is the object of a higher-order representation, which represents the first-order mental state as being conscious. This means that consciousness involves not just a first-order representation of the world (i.e., feeling, sensation), but also a second-order representation of the first-order representation. Consciousness is not just the experience of sensory information or mental states, but also the awareness of that experience of these (Gennaro, 2004). Higher-order theories of consciousness explain that consciousness involves a higher-order mental representation of one's first-order mental states. In this paper, I would like to trace examine the notion of higher-order consciousness in Plato, Rene Descartes, and Immanuel Kant philosophy. One of the earliest references to higher order consciousness can be found in Plato's work, where he suggests that there are different levels of mental activity and awareness, with some thoughts and perceptions being more real or true than others. Descartes also touched on the idea of higher order consciousness in his Meditations on first Philosophy, where he argued that the mind is able to reflect upon and be aware of its own thoughts and mental processes. Descartes proposed the notion of cogito ergo sum, or I think, therefore, I am, - I'm being conscious of my existence is possible because I think, as a starting point for understanding consciousness. Kant in his epistemology mentioned that consciousness or its presupposition is a necessary condition of forming judgment which can be inferred from his notion of appreciation. He believed that the mind is actively involved in the process of perception, rather than passively receiving sensory information. Kant also proposed the concept of the transcendental unity of apperception. In this paper, I will explain the historical background that have influenced the development of theories of higher order consciousness.

Is deep sleep conscious? – Indian philosophical perspective on consciousness in suṣupti

Shruti Bhat¹

¹Research Associate, IIT Bombay, Powai, Mumbai

Abstract:

Indian philosophical schools undertake a critical analysis of the state of deep sleep with the intention of establishing their respective positions regarding whether consciousness is the nature of the self or not. According to the Non-dualists (Advaitins), the state of deep sleep also is conscious, in whatever way they define consciousness as. As against this, the Indian Realists—the Nyāya-Vaiśeṣika and the Mādhva schools—hold the view that there is no consciousness in deep sleep. According to them, consciousness is an adventitious property (guṇa) of the self. Since the state of deep sleep is not directly accessible, these philosophical schools consider two pieces of cognition that refer to deep sleep and use them as a base to analyze deep sleep. Two pieces of cognition are the proclamations of the one who just wakes up from a deep sleep and with a retrospective reference to one's experience, says 'I slept happily and I knew nothing' (sukhenāsvāpsaṃ na kiñcidavediṣaṃ). In this expression, the second part 'I knew nothing' becomes the key point of discussion on whether suṣupti, the state of deep sleep is conscious or not. The expression comprises of two things: knowing nothing and a subject 'I'. Each school provides different meanings and justifications for this utterance to support their view on the nature of deep sleep. The elaborate argument begins by studying the nature of the utterance 'I slept happily, I knew nothing'. According to the Non-dualists, the utterance is a simple recollection. It is a recollection of pleasure and ignorance experienced in the state of deep sleep. In the utterance, the word 'happy' refers to pleasure and 'knowing nothing' refers to ignorance. Indian Realists argue against this and claim that this piece of cognition is an inference. They repudiate the Advaita's position mainly on the grounds that, by definition, deep sleep means the absence of the inner organ/mind. Since the inner organ is absent or inactive, it is impossible to have any cognition. Then, how is it that one can recollect something which is not cognized before at all? Thus, according to the Indian Realists, this piece of cognition 'I slept happily and I knew nothing' is an inference. The word 'happy' refers to an absence of pain and 'knowing nothing' refers to the absence of cognitions. Advaita retaliates this by showing logical absurdities in considering this piece of cognition as an inference and the impossibility of this being any other type of cognition other than recollection.

Analyzing deep sleep has been a challenging task for philosophers. In Western philosophy, the philosophical inquiry about deep sleep runs around the presence or absence of consciousness in that

state. As very well summarized by James Hill, Descartes advocates the soul to be thinking even in deep sleep nevertheless it can produce no new memory. On the other hand, the empiricist, John Lock, simply rejects any consciousness in deep sleep, following the common-sense line. Leibniz gives yet another view that the mind thinks in deep sleep but because of too fragmented thoughts, it does not do so consciously. The process of analysis that leads to such opposed conclusions also seems to be heavily dependent on the different ontological commitments of the propagators.

In this paper, I would like to reconstruct the entire argument between the Non-dualists and the Realists on consciousness in deep sleep. These thoughts are spread in different texts of the two schools and also in the form of *pūrvapakṣa* (opponents' position) in some texts. With respect to the Non-dualist's view, I take the arguments mainly from *Advaitasiddhi* and *Siddhāntabindu* of Madhusūdana Sarasvatī along with some arguments from *Vidyāraṇyasvāmī* in his *Pañcadaśī*. As far as the Indian Realists' school is concerned, I consider *Praśastapādabhāṣya* and *Nyāyakandalī* of Śrīdhara along with *Vyomavatī* of Vyomaśiva and *Nyāyāmṛta* of Vyāsarāya. After briefly presenting their arguments I try to find out whether any of the two positions can answer the contemporary questions in the research on deep sleep and consciousness.

Unlocking the Therapeutic Potential of Marine Actinomycetes: An Integrated Network Pharmacology and Artificial Intelligence-Based Approach for Alzheimer's Disease Treatment

Mayank Roy Chowdhury ¹, Moni Philip Jacob Kizhakedathil ², Karamveer Karamveer ³, Basant Kumar Tiwary ³, Sudarshana Deepa Vijaykumar ⁴

¹Department of Biotechnology, National Institute of Technology, Andhra Pradesh-534101, India

²Department of Biotechnology, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu

³Department of Bioinformatics, School of Life Sciences, Pondicherry University, Pondicherry-605014, India

⁴National Institute of Technology Andhra Pradesh

Abstract:

Background: Network pharmacology integrated with artificial intelligence (AI) has been widely employed to explore the mode of action of traditional medicinal plants from Indian Ayurveda. However, the potential therapeutic value of marine Actinomycetes, an abundant ocean microflora, remains underexplored. This study aims to investigate the therapeutic potential of marine Actinomycetes in treating Alzheimer's disease (AD) using an integrated approach combining network pharmacology, AI-based screening, and molecular docking to validate interactions between core genes associated with AD pathways and bioactive compounds from Actinomycetes. **Methods:** A comprehensive literature mining effort identified 91 bioactive compounds from various marine Actinomycetes species. Subsequently, we applied three essential ADME (absorption, distribution, metabolism, and excretion) screening criteria, including druglikeness ($DL \geq 30\%$), bioavailability ($OB \geq 18\%$), and blood-brain barrier permeability (BBBp between -0.3 and 3), to shortlist 43 promising compounds. In silico toxicological studies further refined the selection to 21 compounds for further investigation. **Results:** Through target prediction, we established associations between these 21 compounds and AD-related genes. Protein-protein interaction (PPI) mapping, gene ontology and pathway enrichment analysis were conducted to gain deeper insights into the therapeutic potential of these compounds. Moreover, molecular docking was performed to validate the interactions between the selected bioactive compounds and core genes associated with AD pathways, demonstrating their potential to modulate these pathways. **Conclusion:** This integrated approach identified promising Actinomycetes-derived compounds with potential against AD. The study highlights marine Actinomycetes as a resource for drug discovery using network pharmacology, AI, and

molecular docking. Harnessing marine biodiversity may offer innovative solutions for neurodegenerative disorders.

Attentional Guidance in Spontaneous Vision

Tapas Rath¹, Nisheeth Srivastava¹, Narayanan Srinivasan¹

¹ Indian Institute of Technology, Kanpur

Abstract:

We did a brief review on the topic of distortion of perception from the six systems of philosophy as part of the Indian Knowledge System (IKS). Then, from modern cognitive psychology, we did a literature review on the factors affecting perception and the relation between attention and perception. Breaking down the problem of distortion of perception into smaller units, we focused on working memory (WM) affecting attention and dove into the empirical studies related to it in cognitive science literature. We realized that the test of the hypotheses on the distortion of perception that we derive from IKS would be complete only when we test them in a task-free setting and that this task-free or spontaneous vision remains unexplored. Therefore, we designed a novel experimental paradigm and tested how the contents of working memory influence the deployment of attention in spontaneous vision. The results show that even in a task-free setting, the contents of working memory influence attention in a predicted manner, however, with a twist of an initial quadrant bias.

Ayurvedic Cognitive-enhancing herbs for Mental Health Care – A review

Dr. Smrutirekha Nayak¹, Dr. Meena Shamrao Deogade², Prof. Dr. Tanuja Manoj Nesari³

¹MD scholar, All India Institute of Ayurveda, New Delhi

²Associate Professor, All India Institute of Ayurveda, New Delhi

³Director & HoD, All India Institute of Ayurveda, New Delhi

Abstract:

Background: The awareness regarding the balanced mental health is increasing and it is now recognized as a major cause of morbidity worldwide. According to world federation for mental health, the mental and neurological disorders affect 1 in every 8 people, or 970 million people around the world. The modern pharmaceutical approaches developed to date do not enhance the cognitive power of humans. Promising synthetic drug candidates of modern science have failed clinical trials in the past decade, suggesting that the mind and its pathophysiology may be highly complex. Medicinal plants and herbal remedies are now gaining more interest as complementary and alternative interventions and are a valuable source for developing drug candidates for mental health care. Many Medhya (cognitive enhancing) herbal drugs has been used for centuries in Ayurveda, alone or in combination with other herbs, as a memory and cognitive enhancer. Indeed, several scientific studies have described the use of various medicinal plants and their principal phytochemicals for their cognitive enhancing effects. **Methods-**This article systematically reviews recent studies that have investigated the role of neuroprotective herbs and their bioactive compounds for cognitive wellness associated with mental health. PubMed Central, Scopus, Google Scholar, databases of articles were collected, and abstracts were reviewed for relevance to the subject matter. Search terms included “Mental health AND ayurveda”, ‘neuroprotective herbs AND ayurveda’, ‘Neuroprotective potential of ayurvedic herbs.

Conclusion: Medicinal plants have great potential as part of an overall program in the prevention and treatment of cognitive decline associated with mental disorders. These medicinal plants can be used in drug discovery programs for identifying safe and efficacious phytochemicals for cognitive enhancing effect. Overall, this review provides deeper insights into the therapeutic implications of these ayurvedic medicinal herbs as a lead formulation for exerting cognitive-enhancing effects and mental health care.

Ayurvedic Perspectives on Neurocognition and the science of Consciousness: Unveiling Ancient Wisdom for Modern Understanding

Khushal Kumar¹, Shalini Rai² and Jyoti Raman³

¹ PhD Scholar, All India Institute of Ayurveda, New Delhi

² Assistant Professor, All India Institute of Ayurveda, New Delhi

³ PhD Scholar, National Institute of Ayurveda, Jaipur

Abstract:

Neurocognition is the ability to think, reason, concentrate, remember things, process information, learn, and understand. It is a crucial component in determining the intellectual supremacy of humans, as they have the unique potential to acquire knowledge, unravel the mysteries around them, and generate new knowledge. The Indian rishis since ages pursued the science of knowledge and enlightenment. Much of that knowledge is entailed in the Vedas and the Ayurveda scriptures. This paper delves into the captivating realm of principles of neurocognition and explores its intricate connection with Ayurveda. Ayurveda, an ancient system of holistic healing, offers profound insights into the nature of consciousness, grounding its understanding in the interconnectedness of mind, body, and spirit. from the Ayurveda perspective incorporating the macro and the micro components. This paper investigates how the mind and its cognitive functions are influenced by the interactions of the body's physiological processes according to Ayurvedic thought. Moreover, various stages of consciousness are recognized in Ayurveda, shedding light on altered states of awareness and their impact on overall well-being. The influence of lifestyle, diet, and practices such as meditation and yoga on consciousness is also explained through an Ayurvedic lens. Through this interdisciplinary journey, the paper aims to foster a deeper appreciation for the complementary nature of Ayurveda and neurocognition in understanding consciousness. By recognizing the significance of these perspectives, we can broaden our horizon in the study of consciousness and pave the way for a more integrated approach to health and well-being.

Role of Ayurveda in healthy mind against inflammation

Nanasaheb Memane¹, Ajay Sankhe¹, Sonal Memane¹

¹Bhakti Vedanta Hospital and Research Institute

Abstract:

Background: Inflammation is the fundamental cause of chronic and recurrent diseases. Multiple antibiotics are insufficient to halt the recurrence of diseases. Lifestyle diseases are a big challenge in modern times. There is a need to understand the role of other factors like diet and lifestyle, mind along with pathogen in disease pathology. Some studies show evidence of negative correlation between depression and inflammatory markers. Indian medicine Ayurveda states a patient as a unit of mind, body, soul. There is a definite involvement of all the components in disease pathology. Charak states in the foremost disease fever senses, mind and body are affected by heat. Negative emotions like greed, lust, anger as causative factors for fever. Mandagni (Low digestive fire) is a major cause for any disease, mandagni leads to Aam formation. Aam is an intermediate metabolic product which causes inflammation. Shopha i.e., inflammation has three stages as Aamavastha, Pachyamanavastha and Pakvavastha, as the stages of pathogenesis of a disease. Aam is the main cause of any disease. Physically exogenous and endogenous causes and mentally greed, illusion, hatred, shame, lamentation, fear, anxiety causes Aam. Manovishad worsens disease and happy mind heals the wound. Food in passion and ignorance causes disease, distress, and lamentation. Goodness food provides good health, longevity, mental, physical energy, happiness. Emotional security leads to reduced recurrence of childhood respiratory diseases. **Methodology:** In Ayurveda department of Bhaktivedanta Hospital. Patients having Chronic recurrent respiratory infection were assessed also with Ayurveda parameters. Ayurveda Herbo mineral formulations working for respiratory system and mind were prescribed as per subjective Dosha imbalance to achieve Tridanda (Body, Mind and Soul) balance, under the supervision of expert Ayurveda physician. Pathyakar Aaharvihar therapeutic diet and lifestyle modification in mode of goodness was advised and regular follow up was taken.

Result: It showed improvement in hypersensitive airways, reducing hyperactivity associated with childhood asthma, improved appetite, reduced recurrence of respiratory infection, increased stamina, and immunity. **Conclusion:** Healthy mind plays a vital role in upregulation of inflammatory pathways.

How Happy Are We? Need for the Gross National Happiness Index in India: Challenges and Resolutions

Rahila Khan¹ , Neetu Singh¹ , Akanksha Pandey¹ .

¹Krishna Institute of Technology, Kanpur

Abstract:

The pursuit of happiness and well-being has gained significant attention in recent years, challenging traditional economic measures such as Gross Domestic Product (GDP). This research paper focuses on the Gross National Happiness (GNH) Index, initially introduced by Bhutan, and its relevance in India. The paper explores the concept of GNH and its four pillars: good governance, sustainable socio-economic development, cultural preservation, and environmental conservation. It examines the multidimensional methodology used to construct the GNH Index, which comprises nine domains, including psychological well-being, health, education, and living standards. The paper discusses cultural differences within India and the difficulty in directly applying a model like GNH Index, which is deeply rooted in Buddhist values, in a diverse and secular country like India. It also highlights alternative models for measuring societal progress, such as the OECD Better Life Index, the Social Progress Index (SPI), and the World Happiness Report. These models offer insights into the well-being of citizens based on various indicators. The research paper presents the performance of India in the World Happiness Report and analyses the factors contributing to the nation's low ranking. It explores issues such as rapid urbanization, declining incomes, corruption perceptions, healthcare costs, women's safety, environmental pollution, and poor mental well-being. To assess happiness levels in India, the paper proposes the use of machine learning tools and social media analysis, leveraging datasets like student questionnaires and sentiment analysis of tweets. Furthermore, the paper discusses the significance of GNH over GDP and highlights the concept of multidimensional poverty.

Examining aperiodic EEG spectral components in schizophrenia during rest and task conditions using both IRASA and SpecParam - an exploratory study

Sachdev Ananya¹, Sasidharan Arun², Venugopal Rahul², Marigowda Vrinda³, Govindaraj Ramajayam², P N Ravindra², M Kutty Bindu².

¹UM-DAE Centre for Excellence in Basic Sciences, Mumbai, Maharashtra, India

²Centre for Consciousness Studies, Department of Neurophysiology, NIMHANS, Bengaluru, Karnataka, India

³Axxonet Brain Research Laboratory (ABRL), Axxonet System Technologies Private Limited, Bengaluru, India.

Abstract:

Background: Schizophrenia is a psychotic disorder that involves an altered sense of reality and is arguably a disorder of consciousness. The balance of excitation and inhibition in the brain is an emerging measure of such altered mental states. The aperiodic or 1/f component of EEG activity has recently come under the spotlight, and with the development of the methods to quantify it - Irregular Resampling Auto-Spectral Analysis (IRASA) and SpecParam (or FOOOF) - numerous studies have been done to explore the aperiodic neural activity in different diseases and mental states, especially in Schizophrenia (see Table 1). Further, there is now strong evidence for the conflation of band-power with aperiodic activity in the traditional analyses, and the need for separating the aperiodic and periodic components has been highlighted. Studies have shown that the steepness of the slope of the aperiodic component is a measure of excitation-inhibition (E/I) balance in the brain (1), and variations in it across the brain have been reported in Schizophrenia. Not only is the slope different in many diseases including schizophrenia, but has also been reported to be consistently steeper across all electrodes in schizophrenia than in healthy individuals, and thus is a potential marker for the disease. While resting-state aperiodic activity in schizophrenia has been studied using both IRASA and SpecParam, and during task using SpecParam, there is inconsistency with respect to reporting the slope averaged across electrodes versus channel-wise reporting and comparing rest versus task. Hence, in this study, we examine the periodic and aperiodic spectral components in schizophrenia versus control in rest and task conditions using both IRASA and SpecParam in the same data. We expect to see a steeper aperiodic slope in the patient group with both methods which will be influenced by task versus rest condition.

Methods: Previously acquired data from 23 schizophrenia patients (SCZ; diagnosed as per DSM-IV) and 25 age- and gender-matched healthy controls (CNT) were used for this analysis (2). All participants

were right-handed and recruited from the outpatient department of NIMHANS or the local community in Bengaluru. A 64-channel Neuroscan EEG System set at a resolution of 24 bits, sampling rate of 1 KHz and a corresponding anti-aliasing filter of 500 Hz was used, while the impedance was kept less than 10 K Ω . Subjects underwent a cognitive task (ANGEL) presented in a sound-attenuated room using the Eprime 2.0 stimulus presentation software which is a gamification of an audio-visual oddball paradigm with three difficulty levels (level 2 is used in the current paper). The task was designed to assess multiple event-related potentials (ERPs) - the C1, P50, MMN, N1, N170, P2, N2pc, LRP, P300, and ERN. Five minutes rest sessions were acquired before and after the above task. The EEG data (11 channels; Fp1, Fp2, F7, F3, F4, F8, T7, C3, Cz, C4, T8, P7, P3, P4, P8, O1, O2) from rest and task sessions were pre-processed in MATLAB ver2021b using functions of EEGLAB ver2021 (down-sampling to 250Hz, 0.5-80Hz band-pass filtering, automated bad channel and segment removal using artefact subspace reconstruction or ASR, interpolation of removed channels, average channel re-referencing and epoching into 3s segments). The 3s epochs were further subjected to power spectral analysis using the Welch method in MNE python and the 1/f slope and intercept of the aperiodic component were extracted using IRASA (YASA toolbox) (3) and SpecParam (FOOOF toolbox) (4) approaches. Statistical analysis was done using a permutation-based t-test and significance threshold set at $p < 0.05$. Penguin toolbox was used to compute t-values and p-values as well as True discovery proportion (significant sites after correction for multiple comparisons) were done using MNE-ARI toolbox.

Results: We found significant differences (uncorrected p-value < 0.05) between CNT and SCZ in spectral aperiodic parameters (slope and intercept) using both IRASA and SpecParam, differentially in Rest and Task conditions (Figure 1). During task condition, slope and intercept were higher in SCZ with both methods, with SpecParam showing significantly higher intercept values in the left posterior site (O1: $t = -2.12$, $p = 0.04$). During rest condition, the right posterior slope and intercept were lower in SCZ with both methods, with IRASA showing significantly lower slope values in the right posterior site (P8: $t = 2.22$, $p = 0.03$).

Discussion & Conclusion: Overall, we observe that the E/I balance of the brain reflected by aperiodic spectral components is different between schizophrenia and controls using two approaches (IRASA and SpecParam), and depends on the mental state (rest versus task). During task there is excessive inhibition (higher intercept) and during rest there is lower inhibition (lower slope) in SCZ. Also, this imbalance during both conditions is maximum in the posterior regions. The current findings are in line with the cardinal role of a multi-dimensional E/I imbalance in schizophrenia pathophysiology (5), which could reflect localized and transient brain network dysfunctions seen to underlie schizophrenia-like symptoms (6). Further studies are warranted in this direction.

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Effect of Yoga based focus-defocus exercise on event related potential(ERP)- EEG pilot study

Shivani Haridas¹, Ramajayam Govindaraj², Arun Sasidharan², Ravindra P Nagendra², Bindu Kuttty²

¹IISER, Mohali

²Centre for Consciousness Studies, Dept of Neurophysiology, NIMHANS

Abstract:

Trataka is a Yoga based cleansing technique. One of the key element of trataka is constant gazing at the centre of candle flame just above the wick (focus) or diffuse focusing on the glow surrounding the flame (defocus) with the eyes still fixed at the centre of the flame. In this study, we explored changes in the event related potential during (N1 & P2) the practice of focus-defocus exercise. Six subjects (2 females) were studied - three yoga practitioners(YP) and three non-yoga practitioners(NYP). ERP paradigm consisted of initial 1-minute rest followed by alternating focus & defocus for 8 minutes. In each 1-minute of focus and defocus, 20 auditory stimuli (1000Hz for 100ms) were presented randomly with an inter stimuli interval of 2-3 seconds. Data was acquired at Cz, Fz & Pz electrode with bilateral mastoid reference using XAMP-10 (Axxonet) (256Hz sampling frequency). Preprocessing and analysis was done with EEGLAB software. The mean N1 amplitude was significantly lesser in defocus condition compared to focus condition ($t = -2.86$; $P = 0.03$; $d = 1.17$) and more pronounced in YP. The P2 amplitude across participants for the focus and defocus conditions showed no significant difference. Lesser N1 amplitude during defocusing could indicate reduced recruitment of neurons in defocusing compared to focusing. In Yogic terms, it would parallel the concept of inaction in action. (ie, despite the brain processing the auditory stimulus, it is relaxed/indifferent). Focusing could enhance concentration & defocusing could facilitate concentration with relaxation. Results need to be interpreted in the context of small sample size.

RagaVR: Automated Day-Night Environment Generation for Virtual Reality through Raga Detection

Rahul Kumar Rai¹ , Reshu Bansal ², Kashik Janbandhu⁴ , Vivek Ranjan ⁴, Shashi Shekhar Jha¹

¹IIT Ropar

²IIT Mandi

³NIT Andhra Pradesh

Abstract:

Background: Ragas are ancient musical compositions found in the Vedic scriptures. They encompass a wide range of melodies, each with its unique characteristics and phrases. Ragas are associated with specific emotions, seasons, and times of day, such as morning, afternoon, sunset, night, late night, and early morning. Time-specific ragas are suited for particular moments, evoking corresponding moods and atmospheres. **Aim & Objective:** This research aims to use deep learning techniques and spectrogram features to classify ragas into five different time zones. Additionally, the objective is to enhance the user experience of listening to ragas by automatically adjusting the virtual environment based on the time of day associated with a specific raga. This approach intends to create a more immersive and contextually appropriate musical experience for the listeners. **Methodology:** The audio samples of the ragas are processed to extract spectrogram features, which capture the frequency and intensity components of the music. These features are then used to train a deep convolutional neural network (CNN). To enhance the user experience, we incorporate Unity scripting, a game development platform, to dynamically modify the virtual environment based on the detected time zone of the played raga. This involves adjusting elements such as the position of the virtual sun and other relevant factors. Finally, we conducted a user study involving 25 participants to evaluate and rate the effectiveness of our system. **Result:** Our system successfully demonstrated the automated generation of immersive surroundings based on the detected time zone of a particular raga. The classification model achieved an accuracy of 78.3% in accurately categorizing ragas into different time zones. These findings validate the effectiveness of our approach in accurately classifying ragas and dynamically enhancing the user experience based on the time of day.

Effect of Mindfulness-based Meditation on Global Graph Measures of the Brain Using EEG

Amit Kumar¹, Shivani Ranjan¹, Lalan Kumar¹, Deepak Joshi¹

¹IIT delhi

Abstract:

A meditation technique called mindfulness has potential clinical applications and is commonly linked to changes in how one objectively evaluates one's cognitive and sensory experiences. The proposed study compares the meditative and non-meditative states through different global graph measures of the brain (average strength, global efficiency, local efficiency, clustering coefficient, assortative coefficient, radius, and diameter) for various frequency bands of electroencephalogram (EEG) signals using Phase lock values.

Exploring the Roots of Consciousness Using Plants

Rajnish Khanna¹

¹Carnegie Institution

Abstract:

Evidence of life on earth dates to 3.8 billion years ago, when earth was less than one-billion years old. Plants and animals shared a common ancestor 1.6 billion years ago. There is debate regarding who is conscious, whether it is an evolutionary superiority limited to humans and some animals. Conventionally accepted theory of consciousness is that it is produced through activities of neuronal networks (biological processes) at macroscale. There are theories of quantum consciousness, and orchestrated quantum-state reduction occurring at microscale (Roger Penrose and Stuart Hameroff). Ancient Indian scriptures describe cognition and methods to improve life and acquire wisdom. Samkhya and Yoga present ancient Indian psychology, a person consists of two components: material (prakriti) and non-material (purusha). Prakriti is relative reality, whereas Purusha is absolute reality or pure consciousness. These concepts go beyond the limitations of modern science, which relies on the ability of measurement. Majority of the components of the universe are unknown, including dark energy and dark matter. Here, in a new theory of “Spatial Relativity”, Einstein’s spacetime is divided into its functional units; starting from the finest “functional-scale”, dubbed Spoton (in contrast to Planck “structural-scale”). The Spoton is informationally proficient (like purusha) as a functional-building-block of any form (like a stem-cell prior to differentiation). Cumulatively, spotons make up a Spotecule, which is the total intrinsic (empty) space in any organized form. Thereby, intrinsic space (spotecule) is distinguished from extrinsic space (either spotons or other spotecules). Spacetime (composed of dynamic spotons) is the medium in which form-organization and -transformation take place. During form development (over time) the spotecule accumulates spatial information specific to the historic path of its organized form. This model also draws parallels between consciousness and photosynthesis as two processes that use quantum information. In photosynthesis, the external information (photon) influences biological systems differentially, based upon localized spatial properties. This theory is testable. For example, anesthetic-induced loss of consciousness can provide insights into the mechanisms. Electroencephalogram (EEG) studies have shown this state to be different from sleep, although some overlap in brain circuitry appears to be involved. Anesthetics used in humans and animals have long been shown to inhibit growth and leaf movement in plants such as Venus flytrap and *Mimosa pudica*. It has been proposed that plants could be a good experimental system to understand how anesthesia works at the molecular level. We are taking a systematic approach to explore the

underlying mechanisms that disrupt plant function using *Arabidopsis thaliana* (mouse cress). This work is ongoing, and we will continue to utilize genetic and molecular tools that are readily available in plant models. The findings may have significant relevance to revealing molecular actions of anesthetics on consciousness, and its relevance to the broader scale of all living systems.

The Concept of Consciousness in Indian Philosophical Texts

Alagar Ramanujam¹ , D Padmapriya¹ , and R Prakash¹

¹Vethathiri maharishi ashram

Abstract:

Consciousness is a familiar word with both the philosophers and the scientists, but it lacks a precise definition. Since ancient times, many thinkers worldwide have pondered over questions like: What is Consciousness?, What is mind? and What is the relationship between the two? Historically, this discussion has been in the domain of philosophers. In today's world, however, Consciousness is also being addressed more frequently by physicists, cognitive scientists and neuroscientists. A theory that appears to be gaining ground in scientific circles is that the entire universe is inhabited by Consciousness (Pansychism). In some physics circles, the prevailing theory is that there is a "Proto-Conscious" field which is an invisible field that inhabits our universe. John Wheeler, a famous physicist postulates that every piece of matter contains a bit of Consciousness, which it absorbs from this Proto-Conscious field. Thus, when a particle absorbs Consciousness from the proto-field, the concept becomes dualistic in character with the particle as one entity and the proto-field the other. This raises additional questions regarding the source of this proto-field and the evolutionary connection between the particle and the proto-field. According to Vedic and Shankya philosophical systems, Consciousness is an attribute of the all-pervading Brahman with Energy being the other attribute of the Brahman. Consciousness exists before the existence of anything else. "Sathyam, Gnanam, Anantham Brahman" says Taitreya Upanishad. (Gnanam means Consciousness) Every system in the universe, is of and by Brahman. Energy makes every system function, while Consciousness in the system manifests as its "order of function." In science the functional order is called a law. It's ironic that we humans recognize the person who discovers a law that is already existing but never think of crediting the Consciousness which became the law. There is no particle in the universe without energy and it is equally true that there exists no particle without Consciousness. Since the entire universe is a collection of particles, the universe has a collective Consciousness that directs the evolution of the universe. In the evolutionary process of the universe, the twin principles of Energy and Consciousness of the Brahman remain inseparable and undifferentiated in the journey from Brahman to the Universe. Consciousness is not just a passive phenomenon but an active agent forcing the systems to obey a particular order. When you look at the structure of an atom, the first (lowest) orbit will have a maximum of only two electrons. If you have a third electron, it can only go to the second orbit as something prevents the third one from occupying the first orbit. That something is nothing but the collective Consciousness of the electrons that prevents the

third electron from occupying the same first orbit. A scientist expresses this behaviour as a law. Thus, a law in physics is nothing but an expression of the functional order in a system designed by the Consciousness of the Brahman. Universe is an excited state of the primordial consciousness. The universe is of Consciousness and by Consciousness. When we say every particle of the universe is of Consciousness, we mean that the material cause of the particle is Consciousness. When we say that every dust is by Consciousness, we mean that Consciousness is also the efficient cause of the particle. For every aspect of a Jeeva the efficient cause and the material cause is consciousness of the Brahman whose existence is independent of anything else. Thus, brain is a product of consciousness and not the other way.

Differentiating Causality from Correlation in Artificial Intelligence models: A Bhagavat Samkhya perspective

Nisargendu Bhatt¹ and Jyotiranjana Beuria²

¹ Institute for Science and Spirituality (ISS), Delhi

² IIT Mandi and ISS Delhi

Abstract:

Correlation and Causation are many times mistakenly considered to be the same. Especially, whenever there is an attempt to develop machines that are compared to humans, causality plays a vital role. For example, in the development of Artificial Intelligence (AI), lack of causality principle is a great hindrance. Although the models used in development of AI are mostly based on correlations, these are often assumed to be causal in nature. Such an approach has been highly successful in terms of the quantitative capability of AI, but lacks in the qualitative (semantic) content. Use of such AI models and relying on its results can be catastrophic in different fields of our routine life such as health care. The solution to this problem lies in first having a clear understanding of causality, correlation and differences between them. Further, the hierarchy in causal structure as conceived in Bhagavat Samkhya philosophy could also be an important aspect for the explainability of the AI systems. This current work is an attempt to throw some light on the lack of explainability of current AI systems and how to overcome it by the inclusion of hierarchical causal abstractions.

Combining both manual and automated quantitative analysis of dream content from multiple dream reports of a single night's sleep - an exploratory study

Jabin Nahida ¹, Kumar Gulshan ², Sasidharan Arun ², Govindaraj Ramajayam ², P N Ravindra ², M Kuty Bindu ²

¹ Indian Institute of Science Education and Research (IISER), Mohali, Punjab, India

² National Institute of Mental Health and Neuro Sciences, Bengaluru, Karnataka, India

Abstract:

Introduction: This study investigates the quantitative analysis of dream content manually using the Hall and Van de Castle (HVDC) scoring system (Hall & Van De Castle, 1966), and multiple automated tools. The research explores whether dreams exhibit consistent emotional valence or a mixture of emotions and examines the relationship between sleep stages and familiar elements in dreams.

Methods: The study sample includes 27 frequent dream recallers in ages 20 to 35 years, and 127 dream narratives were transcribed from 222 recorded awakenings from their single-night sleep. Each dream report was scored for emotional sentiment (Positive, Negative or Neutral) using both manual and automated methods. The report was also assessed for unfamiliar elements using a manual method. Manual analysis was done by two human raters, who familiarized themselves with the HVDC coding system using dream reports of an open-source dream report dataset (<https://www.dreambank.net/>). For automated sentiment analysis, we used multiple Natural Language Processing tools: two simple lexicon-based models ("Vader" and "TextBlob"), a large language model pre-trained on HVDC annotated data ("DReAMy")(Bertolini et al., 2023) and an advanced generative language model ("ChatGPT"). A consensus scoring was then prepared where at least 4 approaches (manual or automated) showed concordance. We also tried to analyze the length of dream reports in different sleep stages by taking the average dream length in each stage.

Results: Manual analysis demonstrated higher accuracy (97.9% for Rater 1, 95.8% for Rater 2) compared to automated tools (Vader: 87.5%, TextBlob: 70.8%, DReAMy: 50%, ChatGPT: 89.5%). The data collected revealed that 21.42% of the subjects reported having diverse dreams (both negative and positive valence dreams) within a single night (Table 1). Among the 127 dream reports analyzed, NREM 2 and REM sleep accounted for 39.55% and 55.22% of the dreams, respectively. Out of the categorized dreams, a higher proportion of positive dreams (16.98%) were reported during the NREM 2 stage, while a larger percentage of negative dreams (52.1%) were observed during REM sleep. NREM 3 had the lowest dream recall (3.8%), and dreamless sleep was more frequent in NREM 2 (18.1%). The

study also revealed a higher proportion of unfamiliar elements (84.2%) in dreams during REM sleep (Table 2). It was found that dream reports from REM sleep are longer compared to those from other sleep stages (Average dream length in REM stage = 31.94, NREM = 23.98, NREM = 17.57).

Discussion: Overall, we show that combining both manual and automated approaches can enhance sentiment analysis accuracy and facilitate a comprehensive understanding of dream emotions. Our findings suggest that it is possible to have diverse emotional valence in dreams in a single night. Moreover, REM sleep facilitates the emergence of more emotionally negative, unfamiliar and verbally descriptive elements in dreams. Such findings will help better plan neurophenomenological studies on dreams and identify brain regions or networks that are involved in emotion processing and imagination for novel interventions like targeted dream incubation (Horowitz et al., 2023).

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Consciousness and Quantum Physics : Confluence of the East and the West

Gagan Jain ¹ and Samridhi Pareek ¹

¹ Manipal University Jaipur

Abstract:

Recent progress in the realm of quantum phenomena holds significant promise for advancing our scientific understanding of consciousness. Traditionally, science and spirituality have been perceived as separate or even contradictory domains. However, the discovery of a non-empirical realm of the universe that doesn't consist of material things but of forms brings these two distinct disciplines together in consciousness studies. These forms are real, even though they are invisible, because they have the potential to appear in the empirical world and act in it. In this paper, we present arguments regarding the possibility that this empirical world is an emanation out of a cosmic realm of potentiality, whose forms can appear as physical structures in the external world.

Psycho-physical basis of food habits: The need for revival of ancient Indian health systems

Dr. Vinayak Rajat Bhat¹, Harsh Agrawal², Ajay Chandra¹

¹ Chanakya University, Bangalore

² Indian Institute of Management, Bangalore

Abstract:

Nutrition and food habits are critical for maintaining optimal physical and psychological health. Contemporary literature often depicts the correlation between food habits, nutritional components, and lifestyle changes with that of psychological health. Research in terms of the role of food habits with that individual's thinking, emotional state, memory, personality traits, reasoning, decision making, and sleep patterns are well established (i.e. in terms of psycho-nutritional statuses). While maladaptive eating habits could lead to various physical and psychological ailments, the need to engage in adaptive and appropriate eating habits is crucial for maintaining holistic health. Eastern perspectives, especially practices mentioned in the Indian Knowledge Systems have highlighted the role of eating habits and the knowledge of food nutrition for optimal functioning and longevity purposes. However due to changing times, lifestyle adaptations in terms of food habits have drastically changed. This shift has resulted in two major outcomes- firstly, the effect of food habits on health (e.g., increased rate of cardiovascular cases / hypertension); secondly, the shrinking knowledge of Indian health systems and practice per se especially due to Western and European influences on food habits preferences. The present paper articulates the need for reviving the Indian health knowledge systems and efforts to devise mechanisms to sensitize about food habits that promote physical and psychological wellbeing from IKS perspective. Various texts evidently mention about ancient Indian practices that prescribed and stipulated recommendations for food habits, selection of nutrition type, eating and cooking mechanisms for specified purposes in greater details. These practices have significant relationship between the mind and body (i.e., both on the physical and psychological health) of a given individual. For instance, this notion is well established in the trigunas and tridoshas conceptualization of physical and psychological health. Given this context, the paper outlines some of the traditional knowledge and practices that existed as part of IKS. While the Indian health knowledge system is a vast, the present paper limits itself to the concepts of food habits and health especially from the framework of trigunas, atman, manas, tridosha. The paper further discusses the role of the relationships between these concepts to that of the psychophysical components of individual health and wellbeing. Next, the paper re-establishes the need for sensitization and introduction of such traditions as part of everyday living.

Choiceless Awareness and Being-in-the World

Hari Narayanan V¹ and Reetu Sharma²

¹IIT Jodhpur

²Independent Scholar

Abstract:

Focused attention or concentration and open, diffused attention or choiceless awareness are often treated as complementary aspects of mindfulness meditation. The former has got a specific object of attention whereas the latter is a matter of being aware of whatever enters the attentional landscape without getting identified with them. Choiceless awareness is quite like what is called *sākṣibhāva* in texts such as Bhagawad Gita. It is even pointed out that cultivating concentration without choiceless awareness can only lead to a state of ‘blissful dullness’. On the other hand, engaging in choiceless awareness without cultivating focused attention can often lead to mind wandering. That is to say, the goal of awakening requires careful nurturing of both types of paying attention. The paper argues that choiceless awareness has got the potential to viscerally realize the fact of being-in-the world and this is integral to the feeling of unity often reported as part of awakening process. This is because mind wandering, with its defining feature of perceptual de-coupling, is largely responsible for the strong psychological boundary with the world, evident in the separative or free-floating self-conception. The paper will begin by discussing the nature of open attention, in contrast with narrow attention, and argue that preponderance of open attention is essential for harmonious relation with the world. This is so because both our object and mode of attention give rise to the reality that we experience. Further, when narrativity is less the mind is more attuned to whatever happens because language, being a case of representation, is not directly related to reality. Harmony with the world can be understood in terms of the contrast between ‘doing’ mode of mind and ‘being’ mode. In the ‘doing’ mode, obsession with control and results of actions are central, and one is likely to feel alienated from whatever cannot be in one’s control. That means, when ‘being’ mode is given its due or even become the default way, alienation with other things will be reduced because one can feel at ease with things that are not, in any way, under one’s control. When narrow attention dominates, maintaining a sharp contrast between the subject and the object becomes the default way and, as a result, there appears a thick psychological boundary between the self and the world. Thus, our real nature of beings-in-the world, is occluded from realizing. As a result, nature, or the rest of the world, including other humans, becomes an object for one’s satisfaction. This cannot help giving rise to internecine conflicts. Cultivation of open attention has got the potential to heal this rift. Thus, the paper argues that choiceless awareness, long recognized as an ineliminable part of

mindfulness meditation and emphasized in various traditions, is of paramount importance in attempts to live with one's real nature or to become more conscious of who we are. References The Mind Illuminated by Culadasa et al Touchstone 2015. The Master and His Emissary by Iain McGilchrist Yale University Press 2009

Indian Human Values Talk About Cognitive Empathy as Well: An Exploration of ‘Anekantavada’ in the Light of Empathy-Altruism Hypothesis

Mannu Brahmi¹, Greeshma Sharma¹, Sutapa Goswami¹, Jyoti Kumar¹

¹ PhD Scholar, Indian Institute of Technology, Delhi

² Project Scientist, Indian Institute of Technology, Delhi

³ Research Intern, Indian Institute of Technology, Delhi

⁴ Associate Professor, Indian Institute of Technology, Delhi

Abstract:

The concept of Anekantavada in Jain philosophy emphasizes on the interconnectedness of the entire existence and all its entities. This understanding requires a recognition by the self of the prevailing veritability of viewpoints, experiences and darshanas, as exhibited by the other entities whilst being observed as seemingly divisive from the observing self. In a modern world dominated by ego-driven, materialistic, self-enhancing values, and hedonistic pleasures, there is a growing call for incorporating universal humanistic values, such as empathy, compassion, and benevolence. This study intended to assess the epistemological role of Anekantavada-based empathetic understanding of the self towards fostering self-transcendental values in an individual. Thus, an investigation of the relationship between emotional empathy, cognitive empathy, and Schwartz's ten universal values was undertaken, with a focus on testing C. Daniel Batson's Empathy-Altruism Hypothesis (2015) within the Indian context of Anekantavada. A sample of 580 respondents (N=580) from Indian colleges was administered the following three questionnaires: Revised Portrait Values Questionnaire (PVQ-RR) (Schwartz et al., 2012), the Interpersonal Reactivity Index (IRI) (Davis, 1980), and the Big 5 Inventory (BFI) (Goldberg, 1993). Results demonstrated a strong positive relationship between empathy dimensions and altruistic values while revealing an inverse relationship with self-enhancing values. In addition, we employed a hierarchical multiple regression model to control for the effects of the BFI personality traits to further explicate this relationship. Intriguingly in our study, both emotional and cognitive empathy accounted for a significant portion of the additional variance in altruistic and self-enhancing values, which stands in contrast to the predominant role of solely affective dimensions in Western samples (Persson & Kajonius, 2016). These findings highlight the role of both emotional and cognitive empathy in the Anekantavadic cultivation of altruistic values, thereby providing evidence for the Empathy-Altruism Hypothesis in the Indian context.

An Indian Knowledge Perspective on Resilience: Examining the Role of Quiet Ego and Non-Attachment

Sutapa Goswami¹, Mannu Brahmi², Gautami Suresh³, Greeshma Sharma⁴, Gayatri Arunkumar⁵

¹ Research Intern, Indian Institute of Technology, Delhi

² PhD Scholar, Indian Institute of Technology, Delhi

³ Research Intern, Indian Institute of Technology, Delhi

⁴ Project Scientist, Indian Institute of Technology, Delhi

⁵ Indraprastha College for Women, University of Delhi

Abstract:

Reverting the gaze from the Western conceptualizations of human resilience towards those of various Indian Darshanas, our study attempts to delve into the metaphysical and transcendental facets of human suffering and self-identity that might reveal significant trait-based contributors to resilience, ultimately leading to a more culturally-relevant, holistic, and nuanced understanding of this construct. The Buddhist ideal of ‘non-attachment’ or the Hindu equivalent of ‘Anasakti’ entails letting go of one’s fixations, material possessions, and desired outcomes and embracing a psychological stance of acceptance, impermanence, and freedom from life’s tumultuous nature. Similarly, transcending one’s own ‘ego’ or ‘Ahaṁkāra’ results in a self-concept that is less self-centered, interdependent, and potentially more psychologically flexible and adaptive in the face of diverse adversities. To test this proposition, a sample of 200 respondents (N=200) aged 20-25 was recruited from urban regions of India and were administered the Quiet Ego scale (QES) (Wayment and Bauer, 2014), Non-attachment scale (NA-7) (Sahdra et al., 2010) and the Resilience scale (RS-14) (Wagnild and Young, 1993). Statistical analysis revealed a strong, positive correlation between Quiet ego (QE), Non-attachment (NA), and resilience. Furthermore, our study investigates a predictive relationship between QE and NA on resilience. The regression analysis resulted in a statistically significant model wherein both QE and NA exert a significant positive influence on resilience with $p < 0.001$, thereby underscoring the importance of a quieted ego and practicing non-attachment as robust predictors of being able to effectively cope with life stressors. Our study’s findings emphasize the role of incorporating these elements into contemplative practices and interventions designed towards targeting resilience. Further, it channels the ancient wisdom of Indian knowledge systems to build a community that goes beyond reductionist viewpoints, and fosters eudaimonic well-being, growth, and adaptive responses to adversity.

Investigating the Effects of Music on Selective Attention

Mayank Tiwari¹

¹Guidance Clinic India Pvt.ltd.

Abstract:

A sample of participants will be recruited from the general population, ensuring a diverse range of ages, genders, and musical backgrounds. Sample size estimation will be based on power analysis, considering effect size from previous studies and desired statistical power. Randomization and Experimental Conditions: Participants will be randomly assigned to either the music condition or the non-music condition. The music condition will involve participants listening to instrumental music, selected based on pre-testing for pleasantness and suitability for the experiment. The non-music condition will involve participants sitting in a quiet environment without any auditory stimulation. Task: Selective Attention - Modified Attention Network Task (ANT): The Attention Network Task (ANT) will be modified to assess selective attention. Participants will be presented with a series of visual stimuli, consisting of a central arrow surrounded by flanking arrows. They will be instructed to identify the direction (left or right) of the central arrow while ignoring the flanking arrows. The stimuli will be presented in three different conditions: congruent (flanking arrows pointing in the same direction as the central arrow), incongruent (flanking arrows pointing in the opposite direction), and neutral (flanking arrows pointing in random directions). The dependent variables will include reaction time and accuracy in responding to the central arrow. Participants will provide informed consent and demographic information. Participants will be familiarized with the task instructions and given a practice session to ensure understanding. Each participant will complete two blocks of the modified ANT, each consisting of trials from the congruent, incongruent, and neutral conditions. The order of the conditions will be counterbalanced across participants to control for any potential order effects. Participants in the music condition will listen to instrumental music via headphones throughout the task, while participants in the non-music condition will experience silence. The presentation of stimuli and data collection will be computerized to ensure consistency and accuracy. The collected data will be analyzed using appropriate statistical methods, such as analysis of variance (ANOVA), depending on the nature of the variables. The main analysis will involve comparing the performance (reaction time and accuracy) of participants in the music condition with those in the non-music condition. Additional analyses may include exploring potential interactions with participant characteristics (e.g., musical expertise, preferences) and assessing any potential moderating effects. Statistical significance will be set at $p < 0.05$, and effect sizes will be reported to determine the practical significance of the findings.

A Survey-based Study During COVID Shows That Lifestyle Factors Correlate with Mental Health

Sonika Thakral¹, A. Ravishankar Rao², Saurabh Mishra³, Alka Mishra⁴, Sumitra A Bentur⁵, Rahul Garg⁶

¹Shaheed Sukhdev College of Business Studies, University of Delhi

²Fairleigh Dickinson University

³Dev Sanskriti Vishwavidyalaya

⁴Dev Sanskriti Vishwavidyalaya

⁵Private practitioner

⁶Indian Institute of Technology Delhi

Abstract:

1. Introduction It has been well-established that mental health and physical health impact each other [1-7]. Psychological conditions are also known to influence the recovery process of patients and therefore management of anxiety and depression in patients is an integral part of treatment for many diseases [8-12]. Thus, the importance of maintaining good mental health cannot be overemphasised. The efficacy of many practices and lifestyle factors prescribed by the ancient Indian traditions of Yoga and Ayurveda in combating mental disorders and maintaining good mental health is also well researched. Some of these are yogic practices such as asanas, pranayama, relaxation techniques (shavasana, yoga nidra) and meditation [13-44]; mantra chanting [45-48]; yagna, agnihotra [49]. Besides, other lifestyle factors have also been associated with mental health such as sleep, diet, exercise, social relationships, recreation and relaxation, spiritual or religious involvement, spending time in nature, etc. [50]. However, an interesting question is whether these practices and lifestyles can prevent or at least minimise psychological disorders, and ensure good mental health and resilience in tough and challenging situations.

2. Objectives This study has a two-fold objective. Firstly, it aims to explore if long-term following of practices and lifestyles suggested in the ancient Indian texts is related to good (or relatively better than others) mental health in as stressful a situation as the COVID-19 pandemic. Secondly, it aims at investigating more, not so well-known, lifestyle factors and habits that relate to good mental health.

3. Methodology A survey was conducted (started in June 2020) with a questionnaire administered through Google Forms. The subjects were recruited using convenience sampling, yielding a sample size of 206. Besides basic personal details, the country of residence and health-related information, the

questionnaire focussed on lifestyle factors/practices and mental health of the respondents. This questionnaire was approved by the Institute Ethics Committee (IEC) of IIT Delhi. The lifestyle factors/practices examined were classified into four broad dimensions, viz. Yogic practices (such as yogasana practice, pranayama practice, yogic cleansing practices, meditation etc.) [51-55], Environmental (both physical and subtle) cleansing practices (such as yagna, agnihotra, fumigation of herbs, mantra chanting, etc.) [56-61], Spiritual practices (praying, visiting religious/spiritual places, reading spiritual texts, etc.) [62-63] and Lifestyle and Nutrition (comprising physical activity, sleep and dietary hygiene, use of turmeric, ginger etc. in food, spending quality time with loved ones and self, regular or need-based intake of Ayurvedic/herbal formulations, dietary supplements etc.) [64-83]. For those indulging in Yogic practices, Environmental Cleansing practices or Spiritual practices, the number of years of indulging determined the score (the more the number of years, the higher the score). Mental health was assessed through questions pertaining to anxiety (GAD-2) [84], depression (PHQ-2) [85] and stress (PSS-4) [86]. Linear regression models were employed to determine the relation between each pair of a mental health parameter studied (regressand) and a lifestyle dimension, with individual parameters in the dimension as regressors (a total of 12 models formed by pairing 3 mental health parameters with 4 lifestyle dimensions).

4. Results and Significance of the Work The results, summarised in Table 1 above, indicate that the number of years of practice of several lifestyle factors and practices suggested by the ancient Indian systems of Yoga and Ayurveda are significantly related to mental health. The number of years of pranayama practice is significantly inversely related to anxiety and depression with p-values of 0.00154 and 0.00289 respectively. The number of years of mantra chanting practice for Environmental Cleansing is significantly inversely related to all of anxiety, depression and stress with p-values of 0.000507, 0.0337 and 0.0177 respectively. Also, reading/listening to spiritual teachings is significantly inversely related to anxiety, depression as well as stress with p-values of 2.68e-05, 0.0127 and 0.0196 respectively. Waking up before sunrise is significantly inversely related to depression with a p-value of 0.0415, while taking adequate sleep of 6 to 8 hrs is significantly inversely related to stress. Finally, moderate physical activity is significantly inversely related to depression, and oil pulling or using oil as nasal drops regularly is significantly inversely related with stress. Besides, visiting religious/spiritual places and yogasana practice turned out to be significantly directly related to anxiety; need-based oil pulling or using oil as nasal drops and rigorous physical work turned out to be significantly directly related to stress. Though the analyses undertaken establish only correlations through linear relationships, there are strong reasons to believe that there exists a causal relationship between the regressors and the regressand in many of the models, primarily because the results comply with the ancient theories as well as existing research literature. Yogic texts state that the practice of pranayama regulates the flow of prana, the vital life force in the body, which when disturbed or imbalanced leads

to diseased states [87-88]. Moreover, several studies have established the efficacy of pranayama practice in combating mental disorders [40-44, 89]. This explains the observation that those with many years into pranayama practice were less likely to develop anxiety or depression. Mantra chanting, as described in Yoga, as well as Ayurveda, is believed to carry out cleansing both internally and externally [53], and this practice has been observed to positively influence the practitioners psychologically [90-92]. This explains why long-term practitioners of mantra chanting could maintain good mental health even during the stressful COVID times. Reading is used to alleviate stress and depression and is often termed as bibliotherapy [93-95]. The utility of reading practice in managing mental health issues has been established through research [96-99]. Our results showing an inverse relation between reading/listening to spiritual teachings and the three mental health parameters can thus be interpreted as the regressor (reading) keeping the regressands (anxiety, depression and stress) under check. However, spiritual bibliotherapy, i.e. therapeutic effect of reading of spiritual texts [100], is not extensively explored. Inadequate or excessive sleep has been found to be a predictor of poor mental health [101-104], though predictability of mental health based on the time one goes to bed and wakes up, is unaddressed. This partly explains the association of sleep with mental health parameters. Regular moderate physical activity uplifts mood, and can be preventive as well as curative for mental health issues like depression and anxiety [105-108]; hence the observed association with depression. The observed direct associations between anxiety and visiting spiritual/religious places, anxiety and yogasana practice, and stress and need-based oil pulling or nasal oil-drops are beyond explanation with the current analysis. However the fourth direct relation between stress and rigorous physical work may be explained because indulging in sports can be hectic; similarly gymming or exercising with difficulty to achieve targets may cause more stress than good. This study can be viewed as a reference standard test for practices and lifestyles prescribed by Yoga and Ayurveda. Their efficacy in ensuring good mental health, even during the stressful COVID-19 pandemic, strengthens the research findings thus far. Our results are mostly in agreement with the existing literature. However, the efficacy of reading/listening to spiritual teachings in maintaining good mental health needs further investigation. This is particularly important because while other parameters may be difficult for one to adopt for various reasons such as incapability to do physical activity or lack of time, a practice as simple as reading or listening to spiritual teachings [109] can be well managed by most people. If proved effective, this practice of feeding one's mind with positive thoughts and teachings, and presumably avoiding negative and stress-inducing readings, can go a long way in bestowing important ingredients of a positive psychological state, viz. optimism, compassion, gratitude and hope, on the reader/listener.

Is Lucid Dreaming Connected with Mental Health? : An Advaitic Perspective

Abstract:

The interconnection between dream consciousness and mental wellness presents a captivating realm for exploration. Dreams, an innate aspect of human consciousness, have intrigued scholars throughout history, drawing speculation and rigorous study. Although there remains much to comprehend about dreams, they are believed to exert an influence on mental well-being and the broader realm of psychological health. Dreams frequently mirror our subconscious thoughts, inner emotions, and past encounters, offering a channel for the mind to work through unresolved emotional matters. Exploring dreams, deciphering their symbols, and recognizing their underlying themes can have therapeutic effects, fostering emotional healing and enhancing self-awareness. This paper will specifically delve into the phenomenon of ‘lucid dreaming’ and investigate the question- ‘In what ways does lucid dreaming help us in improving our overall mental and psychological health?’ Lucid dreaming happens when an individual becomes aware of their dreaming state while still being in the dream. Practicing the technique of lucid dreaming could potentially decrease distressing dreams and nightmares and modify the narratives of these dreams into more positive or neutral ones. It could also provide a safe space for consciously confronting unsolved emotional issues, fears, and anxieties, presenting an opportunity for catharsis and emotional healing. Certain meditation and mindfulness practices can extend into the realm of dreaming and lead to enhanced self-awareness, emotional regulation, and mental well-being. Cultivating mindfulness during the dreaming state can foster mindfulness in the waking state too as individuals become more mindful of their inner emotional and mental state. However, it is important to note that while lucid dreaming has the potential to contribute positively to mindfulness and mental well-being, achieving lucidity requires intense practice, dedication, and patience. Thus, the connection between lucid dreaming and mental well-being is significant as by emphasizing and analyzing dreams, individuals can understand and facilitate their self-awareness, emotional processing, and overall mental well-being.

Given the central role of the Upanishads in comprehending the modern exploration of consciousness, this paper will utilize the Mandukya Upanishad to provide a concise analysis of the stages of consciousness. This Upanishad describes the three stages of consciousness named Visva (waking), Taijasa (dreaming), and Prajna (dreamless sleep), which finally culminate into the transcendent, undifferentiated state of pure consciousness. Based on Advaita Vedanta, I will establish my arguments on connecting dream consciousness and mental well-being. In seeking mental well-being, gaining insight into one's identity and inner essence holds great importance. Advaita Vedanta places a strong emphasis on self-inquiry as a means to comprehend the non-dual essence of reality. In a similar vein,

lucid dreaming serves as a valuable tool for self-exploration and introspection, enabling individuals to access insights into their subconscious mind and thought processes. By engaging in practices like mindfulness and meditation while lucidly dreaming, individuals can cultivate a more profound comprehension of mental processes, and their true selves, potentially enhancing mental well-being. But, 'Will it be possible to mediate and control our thoughts while lucid dreaming'?

The hierarchy of abstractions and causality in mind and matter

Ansul Agarwal¹, Jyotiranjana Beuria²

¹ IKS Centre, Institute for Science and Spirituality, Delhi 110065, India

² IKSMHA Centre, Indian Institute of Technology, Mandi 175005, India

Abstract:

In our attempts to understand the fundamental reality of the Universe many different theories have been proposed in the last many centuries. Philosophers in the past have discussed the existence of the Universe, its causality and teleology. Today, we have come to a point where we have brought mainstream science fully under the physicalist paradigm. Strict adherence to the physicalism has led to the limitation of the non-closure in causal hierarchy. We have many theories explaining the correlation between physical states and mental states, but we still lack a proper understanding of the causal relation between the two characterized by necessity and sufficiency. The content of information associated with meanings generated through faculties of sensation and perception may not be translatable to the properties of matter in physical terms like mass, frequency, momentum, spin etc. Thus, the physical laws that we know today are mere correlations only without proper causal closure. Interestingly, though Bhagavad Samkhya conceives (non)physical ontological structures, it offers a hierarchical causal framework for defining states of matter. So, the state of matter is defined through the hierarchy of latent abstractions leading to the subjective experiences. Thus, such a framework is neither strictly dualistic, nor monistic. In this framework, the state of mind can be phenomenologically defined as a superposed state of possibilities and the state of matter as objectification of latent abstractions. In this exploratory work, we highlight the feasibility of such a hierarchy through some real-world observations.

Assessing Mental Workload in a Dual N-Back Task using Eye-Tracker and Machine Learning Techniques

Rajesh Tiwari¹, Uday Beswal², Nachiket Wadalkar¹

¹Institute of Nuclear Medicine and Allied Sciences, DRDO, Delhi 110054

²Thapar Institute of Engineering and Technology

Abstract:

Cognitive assessment and training through computerized methods is an excellent concept for maintaining cognitive function during occupational/ operational challenges. Multitasking is required during various military operations which creates mental workload. Optimum working memory (visual spatial and auditory) capacity helps in maintaining mental workload. The proposed research work emphasizes the task of assessing the mental workload using eye-tracking measures during a desktop-based dual N-back task comprising three sub-stages ($n = 1$, $n = 2$, $n = 3$). A wearable eye tracker was used to collect eye-tracking data from 29 individuals, and the NASA Task Load Index (NASA-TLX) Score was utilized to calculate the perceived mental workload. The study found associations between participant accuracy on the Dual N-Back test and Pupil Diameter, Shannon Entropy and Fixation Count. These results expand our understanding of the cognitive mechanisms behind dual N-Back tasks and their connection to mental workload. Higher mental workload has been associated with lower fixation count and accuracy, as fixation count and accuracy showed instigative associations with workload. On the other hand, pupil diameter showed a positive association with workload, indicating that higher levels of mental workload were associated with larger pupil dilation. The K-Means Clustering Algorithm, Decision Tree, and Random Forest Classifiers had been trained using the generated dataset and the corresponding accuracies were also derived to use the study results in a conclusive way.

Encouraging the Mean World Syndrome Through Excessive Consumption of Violent Content on Instagram

Dhruvee Sinha¹, Zeeshan Ali¹

¹National Institute of Technology Patna

Abstract:

The research paper investigates the impact of excessive violent media consumption on social media platforms, focusing on the desensitisation and empathy erosion effects among youth. This paper examines the prevalence of visual content circulation on Instagram, the leading platform for sharing photos and videos in India. Through an extensive literature review and content analysis of viral content on select Instagram handles, the study explores media consumption habits and attitudes towards violence among Indian youth. Drawing upon Gerbner's concept of the "mean world syndrome," which suggests that prolonged exposure to violence cultivates a distorted perception of reality, this research examines the extent to which social media contributes to a shift in cognitive development. The findings reveal that constant engagement with violent content can reinforce users' belief that violence is pervasive in society, thereby reinforcing a perception of an unsafe and threatening world. The empirical results provide valuable evidence supporting the negative effects of excessive violent media consumption on social media platforms. The paper highlights the crucial need to understand these effects to guide the development of interventions and strategies aimed at mitigating the potential harm caused by prolonged exposure to violent content, fostering empathy, and promoting a healthier media environment for young users.

Mind the Gap between Consciousness and Creativity

Mukta Avachat-Shirke¹ , Akash Alegaonkar¹

¹Vishwakarma University

Abstract:

Creative process in design is complicated to describe and understand. It is hard to give a robust answer to the question what is a creative process? Creativity uses both cognition and philosophy to generate ideas. Cognitive process includes knowledge of the surrounding through experiences and analytical thinking while philosophy is to understand how knowledge works. Hence considering both cognition and philosophy is necessary to know about the creative process of a designer. Designs are amalgamation of aesthetics and functionality. Designs are mainly created for people. Each human being perceives designs differently therefore a user's or a viewer's role is also important. Indian philosopher and polymath Abhinavagupta's literature has thrown light on both cognition and philosophy. He was a scholar of 'Trika' monistic 'Shaivism'. This study has tried to investigate and relate the thoughts of Abhinavagupta for creativity in design. This study can demonstrate how Abhinavagupta's philosophical concepts in 'Trika' system can be relevant to contemporary times. Researchers have tried to compare Abhinavagupta's concept of 'Prakāśa' and 'Vimarśa' with designers and their designs. Since this paper is from both designer's and viewer's point of view it is focused on the consequences of cognition process and philosophy on artistic creation in design. It will examine the role of consciousness while perceiving designs. It will examine the quantitative and qualitative analysis with data collection from designers and users to understand creative process and also how people perceive designs. The observations stated will throw light on the role of cognitive process and philosophy in creativity.

Impact of spiritual care intervention in health care.

Vijaykumar Gawali ¹ and Ajay Sankhe ¹

¹ Bhaktivedanta Hospital & Research Institute

Abstract:

Background: Usually health care is only associated with medicines but physicians have made an effort to restore medicine's more spiritual roots in recent decades, realising that until recently, spirituality and healthcare were frequently associated. Indian knowledge system of yoga meditation and ayurveda aids in providing improved symptoms in treatment of various diseases and also in quality care and healthy mental well being rather than just extending number of years through the advent of technology, knowledge and medicines in science. This abstract briefs results of few of the randomized controlled clinical trials conducted at tertiary care center. **Methodology:** Impact of Spiritual care (mantra meditation, yoga, exercise) and spiritual intervention under the MATCH guidelines are studied on a variety of indications like covid-19, cancer, generalized depression, diabetes, cardiovascular diseases, haemodialysis. Participants were counselled based on MATCH Guidelines (details below) and various Indian knowledge system of yoga and meditation were administrated as per disease. **M-Mercy :** This principle discourages slaughter of innocent animals but entails our existence in this universe with minimal violence to other living beings and environment. **A-Austerity :** accept the reality of the disease and have a positive mindset through spiritual practices instead of taking temporary shelter of intoxication such as smoking, tobacco chewing and alcoholism and asked them to avoid. **T-Truthfulness :** have straight forward dealings with everyone and avoid stress. **C-Cleanliness :** Maintain good hygiene to avoid infections. **H-Holy name :** pray and meditate on the holy names of God (keeping their faith in their religion). **Results:** Following statistically significant results are evidenced based on interventions stated. - Improvement in glycaemic control, reduction in medication burden and blood pressure was observed in type 2 diabetes mellitus patients. Significant improvement in symptoms of anxiety and depression was noted in the spiritual care therapy group. - Shorter length of hospital stay and lower levels of high sensitivity C reactive protein in spiritual intervention group in patients undergoing percutaneous transluminal coronary angioplasty. - Reduction in Hamilton anxiety and depression scores in generalized depression patients. - Increase in Quality of life and Spiritual Well being scores in cancer patients' and their primary carers' and also in patients undergoing haemodialysis. - Significant reduction in the anxiety levels following daily chanting of Mahamantra in mild to moderate COVID-19 patients ($p < 0.0001$). - Improvement in the work performance of head of departments (as evaluated by their respective employees in health care settings) translating in better patient experience ($P < 0.0001$).

Conclusion: In conclusion, spiritual care has been proved to be beneficial not only in improving overall well-being and quality of life in patients but also in achieving better clinical outcomes for study participants.

Exploring the Samkhya Paradigm in Kalidasa's Abhijnanshakuntalam: A Philosophical Analysis

Dr. Kinjal Bhatia¹

¹Charotar University of Science and Technology (CHARUSAT)

Abstract:

This research paper offers a comprehensive and philosophical analysis of the Samkhya paradigm as portrayed in Kalidasa's masterpiece, Abhijnanshakuntalam. Drawing upon the rich tapestry of Sanskrit literature and ancient Indian philosophy, the study explores the profound interplay between the Samkhya philosophy and the narrative elements of the play. Through a meticulous examination of the characters, plot development, and underlying philosophical concepts, this analysis sheds light on the intricate relationship between the eternal consciousness (Purusha) and the ever-changing material world (Prakriti). The paper delves into the symbolic and metaphorical representations of Purusha and Prakriti, unraveling their implications for human existence and spiritual realization. By employing a literary and formal language at an advanced level, this research unveils the deeper layers of Abhijnanshakuntalam and its resonance with Samkhya philosophy.

Consciousness, TIME Perception and Spirituality

Hillol Biswas¹

¹Wapcos Limited, Power Division, Second Floor, SKV House, 57, Sec 18, Gurugram, India

hillolbiswas@wapcosindia.com

Abstract:

The quest for consciousness has been driving humanity since the dawn of civilization. As the advent of culture unfolded and progressed in different time windows, the original philosophical inquiry transpired into a different knowledge domain. As Barnard Baars mentioned, consciousness was prominently circum-vented in the golden era of consciousness from 1780 to 1910. After 1950, when artificial intelligence (AI) started unraveling to mimic human intelligence, prominent cognitive psychology experiments led to the progress of cognitive psychology. From quantum mechanics to cosmology, understanding the creation of the universe and fundamental laws of nature has been a long-term, perennial quest for physicists who seldom ponder whether it should include consciousness. Interestingly, the fortunate ones who can grasp the inner world consciousness transcendence practically themselves are not rare in numbers across countries and cultures. Is consciousness plausible to understand and explain without spirituality, which ordinary seekers have traditionally been able to bestow with the inner subjective world of self-realization? Is consciousness study thus endeavoring nothing left out at all? This paper intends to discuss the complexity of consciousness and at intersection of contemporary studies of time perception, albeit without being devoid of, among other things, spirituality.

Keywords: Consciousness, Spirituality, Time Perception, Transcendence, Subjective Experience, Levels and States

1 Introduction

Since ancient times, consciousness has been traditional across cultures and communities. In the seventeenth century, mathematician Leibniz first stated that the mind is both for conscious and unconscious processing. In his working line in the nineteenth century, Fechner also theorized about the unconscious processing of the brain. In the paper in 1951, The Concepts of Levels of Consciousness, Margetts cited that the philosopher Paul Carus's theory of the unconscious was inspired perhaps by ancient Vedic thoughts that ascribe four states of consciousness [1]. As Sri Aurobindo mentions in verse seven of Mandukya Upanishad, "The Unseen with whom there can be no pragmatic relations, unseizable, featureless, unthinkable, undesignable by name, whose substance is the certitude of Oneself, in whom world existence is stilled, who is all peace and bliss—that is the self, that is what must be

known” [2]. Historically, it is maintained among the spiritual seekers who have realized this fourth state and are kind enough to express that pure consciousness is a privileged aspect that pervades everything. However, the level of consciousness plot vis-a-vis Contents of Consciousness in the cognitive neuroscience domain, as in Fig 1, is usually devoid of considering this, especially the fourth state, i.e., 'Chaturtham.' Stream of consciousness by William James [3] was postulated in the late nineteenth century. In *The Varieties of Religious Experience* in 1902 [4], he specifically identified four main characteristics of powerful spiritual experiences found familiar and common to individuals from all religions, and he summarized them as follows:

Ineffability, Noetic quality, Transience, and Passivity, i.e., the experience of these events as a passive recipient, where one's own “will is in abeyance” and as if “grasped and held by a superior power” [5].

It is noteworthy to mention that as James postulated, continuity of consciousness without which it could not be called a stream had also cited Time Perception. He further mentioned a fanciful hypothesis: "The knowledge of some other part of the stream, past or future, near or remote, is always mixed in with our knowledge of the present thing [6]." Time perception from *Principles of Psychology* "Where is it this present?", however, is unlikely to be readily found in cognitive psychology and consciousness studies. Physicist Arthur Eddington, in the historical 1929 lectures at the University of Edinburgh, discussed human experience by closing eyes and looking into the inner world while explaining time extension vis-a-vis space extension without limiting space and physical time [7]. Therefore, the quest for correspondence between the objective outer world and the subjective inner world has historically remained an issue circumventing consciousness in one form or another. However, the endless nature of academic re- search debate keeps ongoing.

In modern perception, for the last few centuries, the mind-body problem has been examined from different dimensions. Earlier quest kept on hovering in the Physics and mathematics arena with stalwarts like Eddington and Einstein pondering area it surfaced; however, the development of external objective world scientific prowess perhaps the of late re-wrapped the consciousness study since the 1990s with David Chalmers coinage of Hard problems of consciousness [8]: scholars and academicians across the world gained momentum. Therefore, we are at an exciting juncture wherein scientific blooms are exponentially exploding; still, we view the mind-body problem, at least till the contemporary, far from unanimously. Multiple theories have been proposed to address this interdisciplinary subject, and efforts are underway for possible testing of this hypothesis. As many theories of consciousness are untested and untestable [9], the plausibility of generic acceptance of any or more is food for thought. George Miller (1962), who introduced the concept of the magical number seven plus or minus two in 1956 [10] and shaped the study of memory in psychology, noted, "Consciousness is a word worn smooth by a million tongues." Intriguingly, consciousness is what everyone possesses, but without knowing precisely what it is. Thomas Nagel, in his famous paper of 1974, "What is it Like to Be a Bat," argued

for thoughtfully explaining consciousness from a bat, a fundamentally different creature in species in comparison to others, which is typically bestowed with the ability to hunt prey with ultra-sonic emission. They can remarkably discern exact distinctions of distance, size, shape, motion, and texture, which involves hearing the reflections of their own quick, delicately varying, high-frequency screams from nearby objects. In human, it may be more complex to define what it is, as individual differences also play a role. In the book “*Understanding Consciousness*,” hovering around the “*What is Consciousness*” chapter, Max Velmans posits the problem of consciousness as:

- i) What is consciousness, and where is it?
- ii) How can we comprehend the causal connections between matter and mind, particularly the interconnections between the brain and consciousness?
- iii) What is consciousness used for? How, for instance, does it affect how people process information?
- iv) Which materials are connected to consciousness? Specifically, what neuronal basis of consciousness are present in the brain of a human?
- v) Moreover, finally, how do we properly investigate awareness to learn about its nature? Which characteristics can we investigate in person? Techniques, what aspects call for third-party approaches, and how do first- and third-person observations connect?

Subjective experience, also known as first-person experience, is now a big part of research that builds on consciousness study, especially research that comes after Chalmers's hard problems. Further, the problem is compounded when the unconscious part of the brain's functioning is solemnly roped in as the scope of consciousness spontaneously broadens. As Liftshitz et al. wonder, worldwide, shamans, sorcerers, and sages tend to experience absorption and transcendence, which is puzzling to rightly comprehend why only some people tend to experience [11]. While an acceptable definition is far away from being posed as possible candidates, it is not irrelevant that Cambridge Declaration of Consciousness, 2012, at Sir Francis Creek Memorial Conference, in the presence of eminent personalities from, among other things, neuroscience communities, including Stephen Hawking, stated:

"The absence of a neocortex does not preclude an organism from experiencing affective states. Convergent evidence indicates that non-human animals have the neuro-anatomical, neurochemical, and neurophysiological substrates of conscious states, along with the capacity to exhibit intentional behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates."

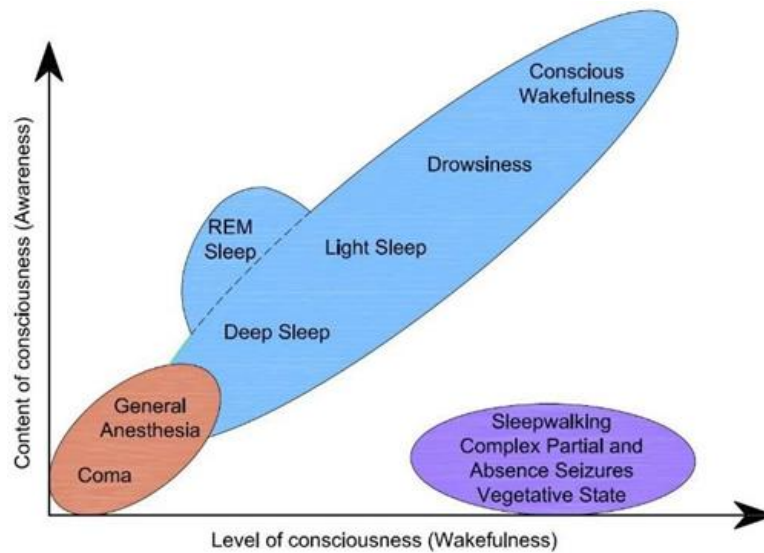


Figure 1: A graphical plot of the level of consciousness and Contents of consciousness[12]

Figure 1 is the 2-dimensional graphical representation of the content of consciousness, and level of consciousness, i.e., awareness and wakefulness are higher in the awakening state, gradually reducing almost in a linear trend of drowsiness, light sleep, and further deep sleep. In the extreme, this graph depicts that in a coma state, both are almost close to zero. In the rapid-eye movement (REM) state, the awareness is high; however, wakefulness is less, and in contrast, in the vegetative state, wakefulness is high, whereas awareness is minimal.

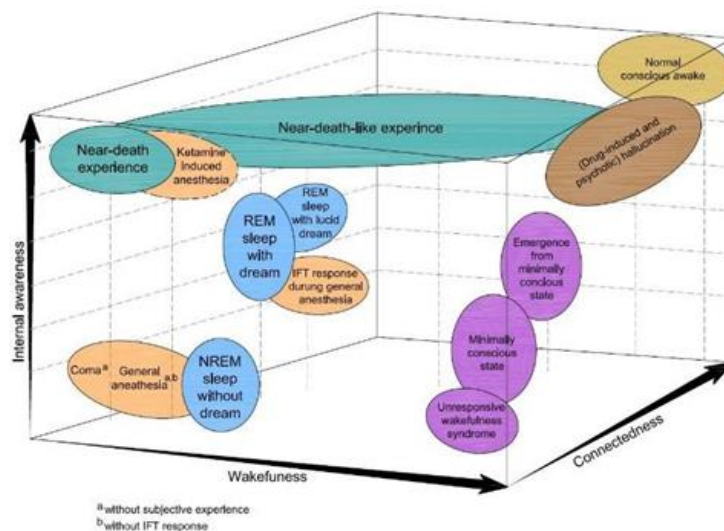


Figure 2: Illustration of Different States and Conditions Based on Wakefulness, Connectedness, and Internal Awareness

Martial et al. further produced the graph in Figure 2 [13] with another plane of connectedness considering Near Death Experience (NDE) research. They spatially transcended with a prosperous state of awareness, wakefulness, and connectedness of the vast reach of consciousness.

2. When Consciousness Supposedly First Transpired in Evolutionary History

Without delving into broader details of the origin of life, it would be unjustified to attract our attention toward the idea of understanding consciousness among other animate beings. Though currently unknown wholly, in human consciousness falls within the hypothetically falsifiable paradigm level, content and self ideally social, after taking cognizance of individual. Therefore, without addressing whether or not consciousness is unique to human beings only, what appears to be relevant that different chronological events transpired when the origin of life in its current form appeared, a few aspects are worth pondering. Hence, without deviating from the topic path, we dive a bit into Life on Earth and its origin to attempt to assume when consciousness could first emerge into life. Darwin wrote to his friend in 1871, "But if (and oh! what a big if!) we could conceive in some warm little pond, with all sorts of ammonia and phosphoric salts, light, heat, electricity, etc. present, that a protein compound was chemically formed ready to undergo still more complex changes . . ."

Stoddart, M.D., MRCP, (1903), in a historical paper on the evolution of consciousness, discussed that "CONSCIOUSNESS is the faculty or function by which we become aware of the existence of our surroundings." Further, he mentioned that no feelings are felt while one is in a deep sleep; awareness is suspended. Moreover, it is not novel to imply that an amoeba feels things. Numerous findings, particularly those by Carter and Romanes, imply that amoebas not only have feelings but also highly developed brain functions like memory and reasoning. However, at this point, all he wants to say about the amoeba is that it is conscious, has feelings, and feels. It is unthinkable for something to feel and not be aware that it is feeling [14].

Schrodinger, in his book 'What is Life' (1944), inculcating the relation between quantum phenomenon and life, put forward a structured framing of the physical basis of life, mind, and matter from different aspects and scientific development then till that point in time [15], [16]. About two decades back, Chalmers coinage of hard problems, moreover, it is worth pondering about Thomas Nagel, who stated in his paper [17], "But no matter how the form may vary, the fact that an organism has conscious experience at all means that there is something it is like to be that organism."

The biological computation hierarchy encompasses subcellular activities and interactions among groups of multicellular animals. A few representative instances of the primary computational processes are given at each level of biological organization; it should be emphasized that the highest levels of

biological computation integrate the lower ones [18]. For instance, neurons contain the string-writing mechanisms of fundamental protein translation and are incorporated into complex cognitive processes [19].

In the book "Structure of Evolution," [20](page 606) Gould argued when considering the duration of our lives, species deaths on geological scales are undoubtedly more discrete and "momentary" than human deaths. Ryan Frank, in the book *Virovolution* [21] (pages 186 – 187), depicts an exciting aspect of the immunity system. "We do know that it first appeared, and very abruptly it seems, with the evolutionary origins of the vertebrates, as represented by present-day bony fish. However, nothing ever appears from nowhere. So, the real question is this: how long ago, whether in the depths of the oceans or during the much earlier epoch of the first living cells, did immunity of any sort come into being, and how, from that primal spark, did the elaborate and rapidly responsive systems we humans enjoy come into being today?" An extensive overview of the origins of our adaptive immunity was published by Luis Villarreal in 2009. In it, he looked at the interactions between viruses and hosts throughout the entire evolutionary history, starting with bacteria and continuing through the earliest animals, like invertebrates, which had fixed but still somewhat effective immune systems, to the vertebrates, where adaptive immunity was first modified by the emergence of mammals, then primates, and finally humans. The article was titled "The Source of self: Genetic Parasites and the origin of adaptive immunity" [22]. In his review, he persuasively argues that intricate evolutionary interactions between phage viruses and their host bacteria led to the emergence of a primitive form of immune identity and, consequently, the first genuine establishment of the concept of "self."

Figure 3 from Encyclopedia Britannica [23] depicts the chronological aspects of geological time-based era, period, and events. The 'Cambrian boom,' or the unexpected discovery of fossils, has puzzled and challenged scientists and biologists since the time of Darwin. Darwin wrote on the Origin of Species in it. He emphasized the belief that ancestors "lived much earlier" than their first fossil representatives. While he thought such a secret record was required to describe the complexity level at which early trilobite fossils could be seen, Darwin needed help figuring out why no related fossils of these older types existed. In chapter 9 of the book on the Imperfection of the Origin, He emphasized "the geological record." The poor state of our paleontological knowledge explicitly stated collections that "no entirely soft organism" be kept safe. Fortunately, lots have been found in the last 150 years, including several examples of Soft-bodied Cambrian and Precambrian fossils. We now understand that the abrupt fossil appearance in the Cambrian era, as in Fig 3 geological time, was 541-485 million years ago. And not the product of a flaw in the fossil evidence of rapid species diversification, animals evolved simultaneously as humans from shells with biomineralization [24].

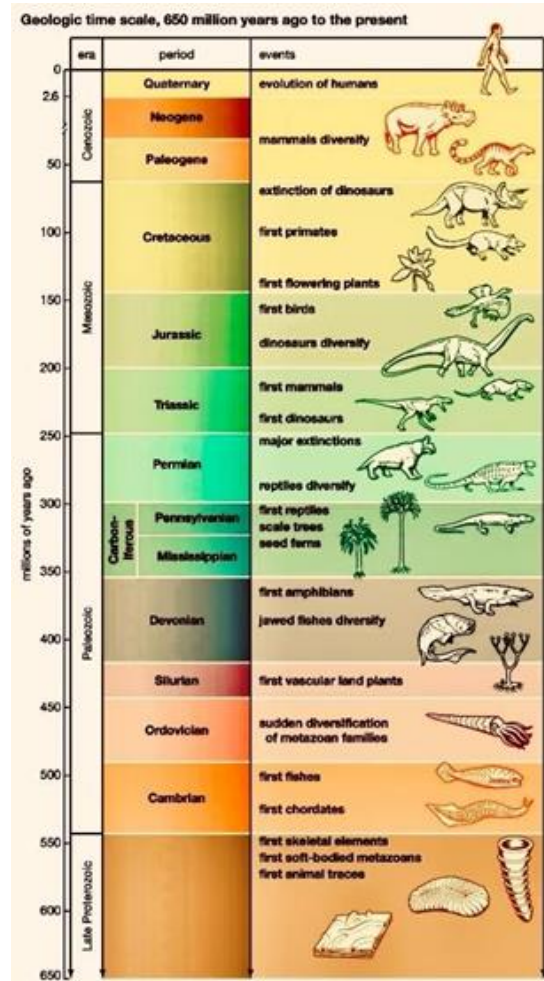


Figure 3: Evolution of species in Geological Time Scale

Though the detailed discussion on this fall outside the scope of this paper, the beginning time, as in Figure 3, i.e., 540 Ma, is noteworthy. A comparative view of various studies led by Barell, Holmes, Lambert, and the modern age's estimate of the Cambrian time scale is produced in Table 1, which closely matches Figure 3.

Table 1: Absolute scale of geological time in million years through different studies [25]

		Barell (1917)	Holmes (1947)	Holmes (1960)	Lambert (1971)	Modern ages
Quaternary (Neozoic)	Pleistocene	1 – 1.5	1	1		4
Tertiary (Cenozoic)	Pleistocene	7-9	12-15	11	7	12
	Miocene	19-23	26-32	25	26	26
	Oligocene	35-39	37-47	40	38	37
	Paleocene	55-65	58-68	70	65	65
	Eocene					
Secondary (Mesozoic)	Cretaceous	120-150	127-140	135	135	141
	Jurassic	155-195	152-167	180	200	195
	Triassic	190-240	182-196	225	280	280
Primary (Paleozoic)	Permian	215-280	203-220	270	280	280
	Carboniferous	300-370	255-275	350	370	345
	Devonian	350-420	313-318	400	415	395
	Silurian	390-460	350	440	445	435
	Ordovician	480-490	430	500	515	500
	Cambrian	550-700	510	600	590	570

Puetz [26] cited the Equation 1 represents the linear relation of length of day (LOD) in hours with geological time:

$$h = 24 - 0.00417673 * t \quad (1)$$

Where h is the hours per day, and t is the time in million years (Ma).

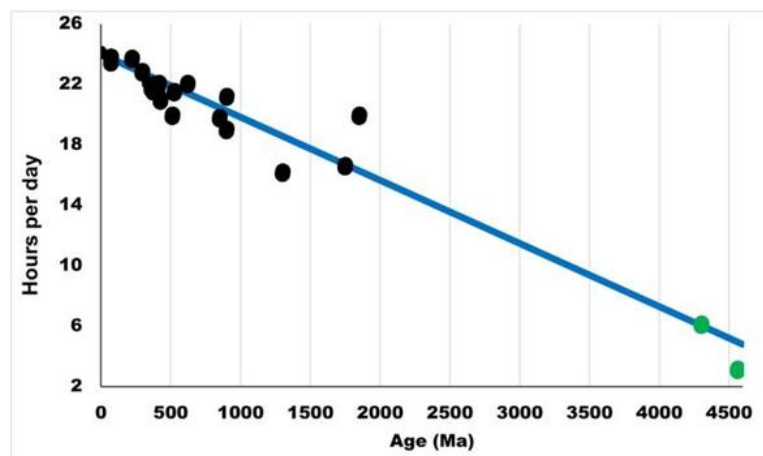


Figure 4: Hours per day on Earth as a function of time. Estimates determined from Eq 1

Comparing Fig 4 of hours per day, it reveals that the day duration circa 550 Ma was about 21.74 hours compared to 24 hours a day, for the Earth's rotation. We leave out to delve into the revolution period of the Earth, whether it was precisely 365 days in a year!

Researchers have found that the modern human life history profile first appeared either at the start of the hominin radiation (around 6 Ma), with the appearance of the genus Homo (around 2.5 Ma), or much

later, possibly only with *H. sapiens* (about 200– 100 Ka) [27]. Therefore, in the modern civilization that blossomed with awareness and maintaining time, the critical building block of today's where we are is a relative term. Perhaps we were not supposed to be at the same juncture at the beginning of the Cambrian era, given that all other conditions were the same as today, should the length of day be different! Archeologically, the earliest indications of self-perception formation through reflection and mirror use, the interaction between humans and psychoactive plants at first, and the altered state of consciousness in shamanism are all somehow connected to consciousness and its evolution. Even though it is undoubtedly one of the most critical aspects of human development, the origin of the sense of Self is rarely the subject of explicit archaeological study. From an archaeological standpoint, there is no way to predict how, for example, the people who lived in the Blombos cave in Africa chronologically would have reacted to seeing their faces and bodies reflected on the mirror's surface [28]. However, the concept of Self, which is being researched about social, cultural, and similar settings, presumably surfaced since then, though exact time prediction appears impossible.

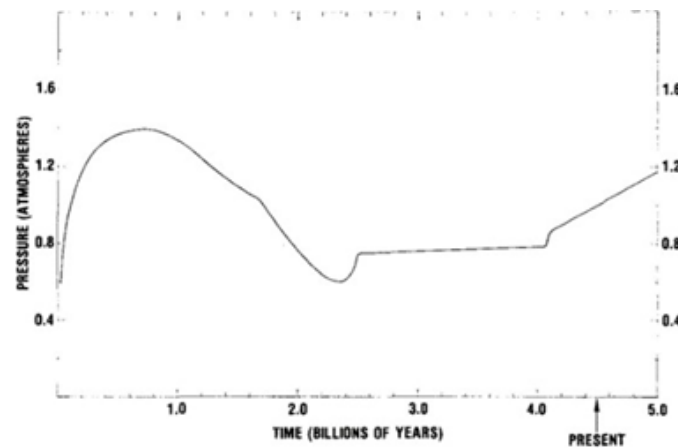


Figure 5: Atmospheric variation with geological scale

It has yet to be determined when consciousness transpired in humans since other prominent factors like atmosphere variation with geological time, as Figure 4 [29] depicts, also played their role. However, the above is indicative that it would be unwise to discard the idea that the length of day in hours did not play a role in evolution vis-à-vis consciousness. We intend to start here to relate the relevance of understanding time perception.

2.1 On Few Theories of Consciousness

In the modern scientific era, consciousness has historically intrigued many pioneering minds. Wondering upon "What kind of material process is directly associated with consciousness?" on the publication of Sir Charles Sherrington's *Significant Man on His Nature*, Schrödinger (1944) describes

it as the sincere search for impartial proof of the interaction between mind and matter [15](page 121, mind and matter). Sir John Eccles received personal encouragement to explore the subject of consciousness from his mentor, Charles Sherrington. "Does your colleague Popper take any interest in that border-land between psychology and physiology, which I used to be attracted to?" Sherrington wrote during Popper's visit to Eccles. (1977, Eccles and Gibson) [30]. Historically, it is no surprise that consciousness attracted the attention of Nobel laureates as well, viz Sir Roger Penrose[31], Sir Francis Crick[32], Gerald Edelman[33], Sir John Eccles[34], Sir Charles Sherrington[35].

Beck and Eccles (deceased) elucidated the idea about the epistemological question of quantum processing in the brain, dating back decades [36]. Their corresponding Figure 5 provides a simplistic view of Quantum processing of the brain surface for its criteria since it relates to the wave equation, which eventually leads to the Schrödinger equation, which is both time-independent and time-dependent. Simply put, for sensory-driven inputs that invariably have a time component inherent in them, a role of time, and thus perception, is irrefutable in the consciousness domain. Nonetheless, recent observed quantum vibrations in the brain have opened another interesting albeit thoughtful direction in the study.

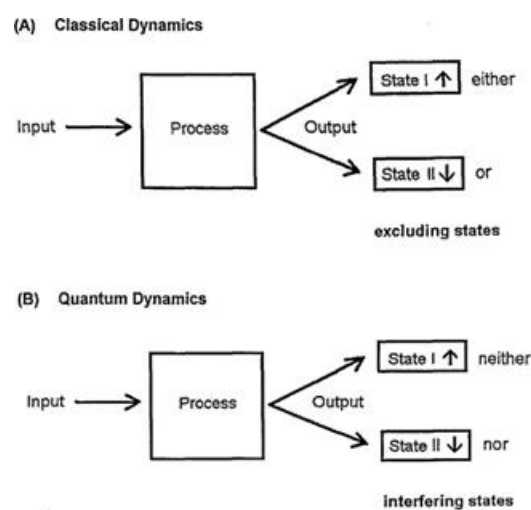


Figure 6: Diagram showing the evolutions of quantum and classical systems. The same preparations yield varying results: (A) leaving out states, (B) states that interfere.

Tononi, while proposing integrated information theory (IIT), postulated that, ultimately, it's critical to recognize that conscious experience develops on a distinct spatiotemporal scale [37]. It cannot be significantly faster or slower than its characteristic speed, for example, as it moves through time. In ORCH OR theory, Penrose and Hameroff posit that their reasons suggest that the threshold of quantum

gravity for self-collapse is relevant to consciousness because individual macroscopic superposed quantum states have different spacetime geometries. Although these geometries are also superposed and "separated," the superposition of spacetime geometries becomes increasingly unstable and simplifies to a single uni-verse state when enough separation occurs. The bounds of the instability are determined by quantum gravity; we argue that Nature's actual choice of state is non-computable. Consequently, every Orch OR event is a self-selection of spacetime geometry connected to the brain by biomolecules such as microtubules [31, 38, 39]. Baars Global Workspace theory, the theatre analogy, does indeed consider unconscious processing. According to the global workspace theory's theatre analogy, the conscious and unconscious brain functions are based on the theatre stage, audience, players, and back-stage areas [40]. SPHERE MODEL of consciousness posits that given that working memory and focused attention (FA) are both linked to the Narrative Self, we propose that the two processes will be electro-physiologically related to FA meditation [41].

Afrasiabi et al. demonstrate that intricate interactions between posterior parietal and deep brain areas are essential for supporting consciousness using neural activity in these various regions and a computational technique. In addition to reliably indicating the distinction between awake, sleep, and anesthesia, posterior parietal and deep brain regions can also detect minute shifts in consciousness brought on by deep brain stimulation [42]. However, Chalmers quickly notes that it has been demonstrated that a few quantifiable estimates of its quantitative measurements correlate with consciousness level. Furthermore, integrated information spatiotemporal patterns (which roughly correspond to IIT's qualitative measures) have been extracted from brain regions and associated with the information contained in conscious perceptions of faces and other objects. They will treat IIT as a possible empirical explanation of consciousness in any scenario [43].

3 Time Perception and Spirituality, two rightful sublime facets

Understanding time perception lets us revisit what time is all about, the way it is meant by hundreds of years of civilizations. The definition of time as in the Cambridge dictionary:

“the part of existence that is measured in minutes, days, years, etc., or this process considered as a whole”.

National Institute of Standards and Technology (NIST) states:

“Time is the most measured quantity on Earth. It tells us when to wake and sleep, when to plant and harvest crops, and when buses, trains, and planes will arrive. It helps organize our lives and coordinate our activities. Scientists use time to measure and better understand countless things in our world.”

Bureau of Standards, Paris, states:

“The second, symbol s, is the SI unit of time. It is defined by taking the fixed numerical value of the cesium frequency $\Delta\nu_{Cs}$, the unperturbed ground-state hyperfine transition frequency of the caesium-133 atom, to be 9 192 631 770 when expressed in the unit Hz, which is equal to s^{-1} .”

Therefore, if we consider time as a measure of frequency, the construct is the length, i.e., duration, and is often considered correspondingly as a continuum of events in memory. From a psychological perspective, rarely does anyone tend to perceive time as the root cause of the Earth's rotation and revolution, let alone the atomic level frequency! As evident from the above figures and tables, the duration of time in respect of day has never been constant!

Time perception is the mental representational outcome of objective world events happening in the course of physical time flow. Often, timelessness in qualitative terms is used to describe serenity. However, the perception of time perception is the continuum of events that is nurtured in the memory framework. In contemporary times, it is the duration of rotation of the Earth, roughly twenty-four hours a day. Since the beginning of the creation of the Earth, the length of day, i.e., the day duration, has never been constant, as shown in Fig 4 [44], wherein the plot of duration in hours per day is plotted against the age of the Earth, which is considered as estimated 4.5 billion years. Green dots represent angular velocity estimates from gravitational constraints; black dots are derived from paleontological data; and blue line is the linear least squares fit, with the y-intercept set to 24 hours per day. The civilization's history is several thousand years compared to the astronomical quantum of the age of the Earth. Nonetheless, at least for a few thousand years, it is twenty-four hours a day, leaving away the leap year period. With time, what transpired in us is rhythms such as circadian and circannual ones contributed by the Earth's rotation and revelation that led to a profound biological effect over time.

Though early research in the psychology of time perception remained a distinct place till 1949, individual differences remain a crucial factor for limiting the research in the arena. Nonetheless, the relationship between physical time and the growth of subjective duration has been, by and large, limited to the focused areas. Time perception, whether good or bad, Matthews identified three key challenges, i.e., (1) Individual differences in the mechanisms and substrates of interval timing; (2) the sensitivity of time perception to the particular circumstances in which the time interval is experienced; and (3) the fact that the stimuli and tasks used in most interval timing experiments are far less complex and dynamic than the "real world." [45]. However, these are primarily psychological cognition bases that are temporal relation-oriented.

Vierordt's Law proposed by Vierordt (1868), research on psychological time dates back to who found that the same rule applies whether the time period is seconds or years: judgments with small intervals are lengthened, and those with large intervals are reduced. [46]. James [6] wrote that "the practically cognized present is no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look into two directions into time" (p. 609). He added that people "are constantly conscious of a certain duration—the specious present—varying in length from a few seconds to probably not more than a minute" (p. 642). It has been discovered through research that the brain can

compare and analyze relatively recent high-density memories in working memory within this time range of roughly 3 to, potentially, 7 seconds. Block et al. reviewed the works on time perception judiciously. Different time scales for sensory, perceptual, attentional, and memory activities are necessary for psychological time. From milliseconds to seconds, minutes, hours, and lifetimes, these are all possible. Many various factors, including attentional processes and environmental changes, influence psychological time [47]. Schroots, in his paper *Time: Perceptions and Concepts*, described in detail distinguishing various times, viz. biological time, physical time, social time, psychological time, time perception and time perspective, as well as intrinsic time. In Figure 7, he describes that the early decades of life contain more biological activity, such as metabolic activity, than later decades. As a result, the biological measuring rod's early portion appears longer than the corresponding portion of the chronological measuring rod. On the other end of the spectrum, the relationship is the opposite [48]. Stroop (1935) proposed the ability of cognitive interference as a measure with function of time known later as the Stroop test. Endeavoring Eddington's lecture in 1929 on time perception, Lehman (1967), in 'time and psychopathology,' being a trained psychiatrist, proposed distinguishing between external and internal time [49]. He further elaborated that time outside of our body is absolute, universal, and objective. It is the actual clock time as expressed within a conceptual framework and measured by instruments. Internal time is individualized, relative, and subjective. It is the idea that endures.

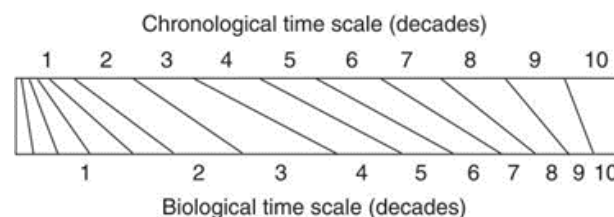


Figure 7: Comparing the biological and chronological time scales schematically

Further, we do not intend to omit another prominent criterion in the origin of life thus consciousness, i.e., gravity. Gravity is a well-known but little-understood physical force. Its intensity and direction have been constant throughout evolutionary history on Earth, making it difficult to understand what role, if any, this vector force may have on life as we know it [50]. Gravity is the only fundamental force that has stayed the same throughout Earth's history, so all living things have changed to be able to handle it. The physiology, structure, function, and behavior of organisms, including plants 2,3,4,5,6, are fundamentally altered by any change from Earth's gravity (1 g) to either hypergravity or hypogravity. "Hypergravity," often written as "more than one g," is when the force of gravity is more vital than the Earth's. Hypergravity can be made by making special centrifuges that can precisely control accelerations that are higher than 1 g [51].

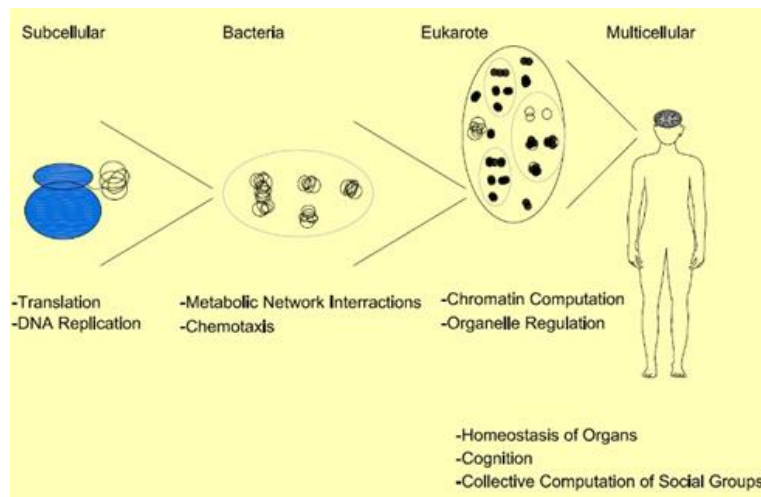


Figure 8: The biological computation hierarchy encompasses subcellular activities and interactions among groups of multicellular animals

Figure 8 [19] depicts a few representative instances of the primary computational processes given at each level of biological organization; it should be emphasized that the highest levels of biological computation integrate the lower ones [18]. For instance, neurons contain the string-writing mechanisms of fundamental protein translation and are incorporated into complex cognitive processes. However, at some point in time, consciousness transpired into humans, whether that is concurrent with the time of development of cognition as in Figure 8 in the evolutionary process, which is another aspect that is not entirely irrelevant. It could be reasonable to assume that carbon serves as the foundation for life on Earth and, if so, that life exists elsewhere in the solar system due to the atomic structure of carbon [52]. Further, in the thermodynamics of life, activation Energy and homeostasis are also factors in the gradual development of the concept of the Self and social group, i.e., Self, which are also other aspects of the biological processes that ultimately led to what we are today, and correspondingly in consciousness study in the paradigm of level, content, and Self [53]. Citing Chyba, Grady noted [52] that it is likely that at this stage of Earth's history, an atmosphere formed and was repeatedly stripped away in a cycle of increasing stability interspersed with bombardment episodes. However, over time, the Earth's atmosphere was retained, the oceans formed, the inner solar system grew more passive, and the conditions were right for life to arise. However, there is little that is known for sure about this period, which is the interface between the Earth's biological and geological histories.

Though not wholly essential, however, we intend to encroach very briefly on gravity to ensure that we are speaking on the track by introducing time perception in consciousness study. In microgravity,

neither humans nor inanimate objects experience any sense of weight. When astronauts and items float in space, the consequences of microgravity become apparent. There are different ways to feel the effects of microgravity. Micro-gravity is when the effects of gravity are so minor that they can be ignored. They can float within their spaceship or go on a spacewalk while in microgravity. Heavier things are easier to move around. For instance, astronauts can manipulate hundreds of pounds of equipment with just the tips of their fingers [54].

Endothelial cells (ECs), which line the inside of blood vessels, are essential for keeping the integrity of blood vessels and the balance of tissues. They control how blood flows in different areas and other physiological processes. High mechanical sensitivity includes hypergravity and microgravity for ECs. They change morphologically and functionally in response to variations in gravity [55]. Research has been ongoing for quite some time to look into how gravity affects the transmission of signals from the cytoskeleton to the nucleus [56][57].

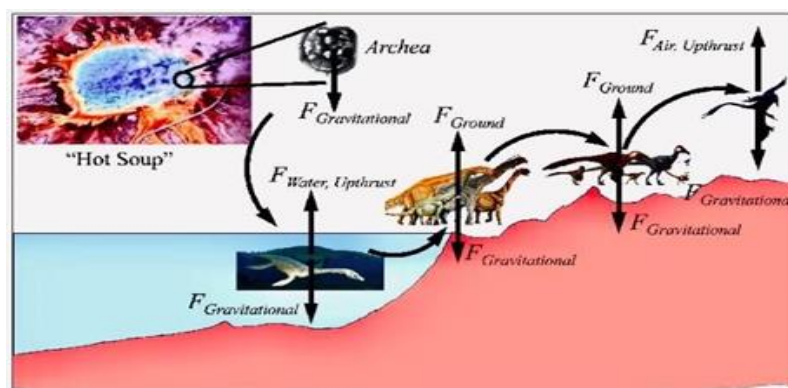


Figure 9:Gravity played a crucial role in the evolution of species

Typically, four forces act on a flying object, i.e., gravity, lift, thrust, and drag, which is also the concept used in aircraft mechanical design. As in Figure 9 [58], gravity plays a role in the evolution of life for flying animatic beings. Understanding the effects of hypergravity, which are gravitational forces more substantial than those on the Earth's surface, is becoming increasingly important as we try to figure out how to use modern aircraft technology and space travel to our advantage. The nematode *Caenorhabditis elegans* has shown to be an effective model for analyzing the impacts of different gravity regimes and has shown outstanding resistance to spaceflight. The study looks at how short-term and controlled exposure to hypergravity affects how *C. elegans* moves, how many babies it has, how fast its pharynx pumps, and how long it lives. The results of this study add to the growing body of research on how different gravity patterns affect life on Earth. They also help us learn more about how *C. elegans* reacts to shorter periods of exposure to more important gravitational forces [59].

Table 2: Estimated Length of Day in different geological eras and corresponding estimated evolution events

Time (Ma)	LOD(Hours)	Era	Period	Events
2.6	23.98914	Cenozoic	Quaternary	Evolution of Humans
50	23.79116		Neogene	
60	23.7494		<i>Paleogene</i>	<i>Mammals Diversify</i>
100	23.58233	Mesozoic	Cretaceous	Extinction of Dinosaurs
120	23.49879			First Primates
140	23.41526			First Flowering Plants
150	23.37349		Jurassic	First Birds
180	23.24819			<i>Dinosaurs Diversify</i>
200	23.16465		Triassic	First Mammals
225	23.06024			First Dinosaurs
250	22.95582	Paleozoic	Permian	Major Extinctions
275	22.8514			<i>Reptiles Diversify</i>
			Carboniferous -	
300	22.74698		Pennsylvanian	First Reptiles
			Carboniferous -	
350	22.53814		Messapian	Scale Trees, Seed Ferns
400	22.32931		Devonian	First Amphibians
425	22.22489			Jawed Fishes Diversify
450	22.12047		Silurian	First Vascular Land Plants
				<i>Suden Diversification of Metazoan families</i>
490	21.9534		Ordovician	
500	21.91164		Cambrian	First Fishes
550	21.7028			First Chordates
		Late Pro-		
600	21.49396	terozoic		First Skeletal Elements
625	21.38954			First Soft body Metazoans
650	21.28513			First Animal Traces

The evolution of species suggests two large-scale aspects: the period in billions of years of age of the Earth and the evolution of species' present shape. Again, two things are important, i.e., pattern and rhythm. A recent study assesses dinosaurs' disappearance as associated with, most likely, the fine dust released into Earth's atmosphere after the collision, which was more likely caused by pulverized rock dust. For over significant years, plants could not photosynthesize, a biological process essential to existence, because of the sun's partial blockage caused by this dust [60]. However, it is unlikely that the event was widespread throughout the globe, given that the globe was a supercontinent then. Our contending assumption is that the role of the Earth's length of day, which in turn impacts the corresponding length of a year, is unlikely to rule out a role played for the gross disappearance of dinosaurs throughout the planet.

Combining with Figure 3 and based on equation 1 that leads to the graph in Figure 4, table 2 provides a tabular form of geological time scale era-based evolution of corresponding species and the length of day in hours. However, it is interesting to note that Table 2 reveals, prima facie, that biological events and geological events are not purely unrelated, viz. for the length of day (LOD) less about 22 hours, Ordovician period Suden Diversification of Metazoan families happened, for the length of day (LOD) less about 23 hours, Permian period major extinctions occurred, about for length of day (LOD) about 23.5 hours dinosaurs disappeared, and quaternary period evolution of humans occurred when for length of day (LOD) is about 24 hours. Nonetheless, we will not encroach upon this further deviating from the current topic.

The rotation of Earth coupled with, among other things, energy from sunlight caused rhythms in species; according to the Two-Process Model for Sleep-Wake Regulation, Process S, the homeostatic sleep drive

increases along with the corresponding feeling of drowsiness during the waking state, during the day into the evening. Interaction between Process S and Process C of the circadian rhythms occurs when the evening transitions from light to dark, indicating a rhythmic shift towards sleep. As a result, in the evening, Process C's circadian arousal drive decreases and, in concert with Process S's homeostatic sleep drive, sleep commences. That basic process is inverted in the morning because Process S's sleep drive has significantly decreased since Process C's circadian cycles and sleep communicate arousal or awake [40]. Borbély (1982) proposed the Two-Process Model of Sleep Regulation Figure 9, which states that sleep is controlled by a mix of sleep-wake homeostatic mechanisms (Process S, depicted in the yellow box) and circadian rhythms (Process C, shown in the grey box). In its original form, Figure 10 Borbély's (1982) description of sleep regulation involved the interplay of two groups of activities. Process C (left panel): As nightfall draws in, circadian rhythms indicate when to sleep. These rhythms are shaded orange. Process S, seen in the right panel, causes homeostatic processes to raise sleep debt during the day, reaching a maximum at night when circadian rhythms signal to sleep.

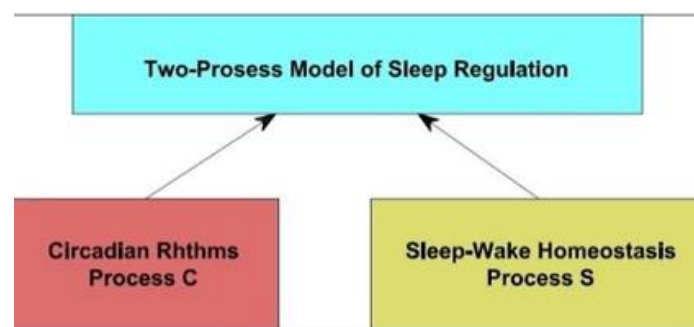


Figure 10: Two-Process Model of Sleep Regulation

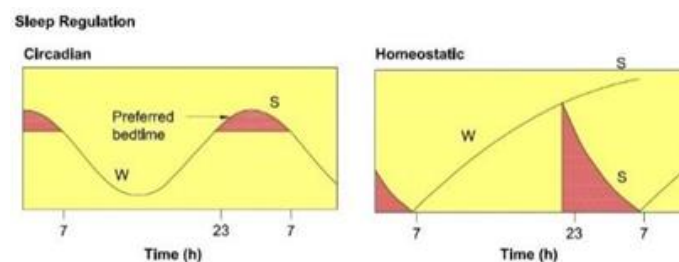


Figure 11: Description of sleep regulation

Figure 10 [40] represents a sleep stage hypnogram for a young adult in good health. The sleep stage is shown by the vertical y-axis on the left side of the picture, which runs from Awake to Stages I–IV (also known as Stages 1–4). The sleep duration is displayed on the horizontal x-axis, which starts at 11 p.m. or 23 h. On the right side of the picture, the vertical y-axis represents rapid eye movement (REM) sleep,

which is indicated in solid black on the hypnogram. REM sleep predominates in the latter hours of sleep, while non rapid eye movement (NREM) sleep dominates the early hours of sleep.

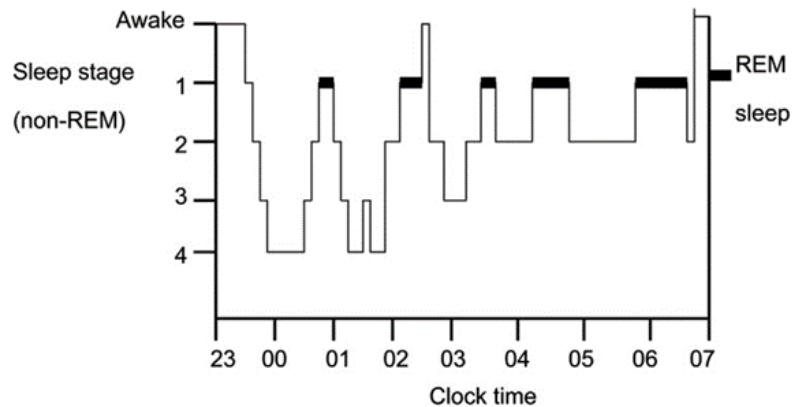


Figure 12: A healthy young adult's sleep stages hypnogram

For most species, rhythmic changes in behavior and physiology are determined by the daily cycle of light and dark. According to studies, a biological clock that regulates these alterations in animals resides in two brain regions known as the suprachiasmatic nuclei. The rhythms of circadian determined by this clock occur all over nature and last roughly 24 times [61]. Circadian and Circannual rhythms in humans are biological rhythms. Any recurrent endogenous cycle (behavioral or physiological) that persists in constant conditions in the absence of geophysical or environmental temporal cues. Circadian rhythm: Endogenous rhythm that is approximately one day in length. Circannual rhythm is an endogenous rhythm that is approximately one year long [62]. The timeframe of an ultradian rhythm is brief (seconds, minutes, or hours), whereas the span of a circadian rhythm is roughly one day. Two well-studied examples are the 40-minute ultradian cycle of cellular respiration in yeast and the mammalian master circadian clock in the brain. Circadian rhythm disruptions are significant in cancer, sleep disorders, and mental health. At the molecular level, ultradian and circadian clocks have similar components [63].

Because of this, circadian rhythms can be found in almost all ways to measure how tired we are and how well our brain and body are working. This explains why people are less awake in the morning or at night, even after getting enough sleep the night before. Different things, like posture and background noise, can make it hard to see the circadian rhythm profile of neurobehavioral performance. This is why studying this rhythmicity in carefully controlled laboratory settings is essential. Also, the system that controls neurobehavioral activities during waking has several masking factors, such as sensory stimuli and body movement [64].

The brain's suprachiasmatic nucleus controls both types of rhythms (SCN). Understanding the molecular and endocrine processes that underlie biological rhythms is essential for basic research and more extensive environmental and medical applications [65]. Both these effects are remarkably

reflected in the shape observed. From horizontal posture to vertical posture. In doing so, what is the primary effect that counteracted? Nonetheless, the gravity. From Figures 10, 11, and 12, the circadian and circannual rhythms in 24 days and 365 days culminated in the present human daily neurobiological cycle. As we see that LOD has been different in different geological time scales, an invisible relation with time appears irrefutable to dispense.

3.1 Archaeological notion of time

Whorf, in 1956, in the book *Language, Thought and Reality*, mentioned time as a "smooth flowing continuum in which everything proceeds at an equal rate" [66]. In an anthropological wondering, Barbara Adam in *Perception of Time* [67] brilliantly notes time perception, how we understand and interpret that experience differs throughout cultures, historical eras and settings, individuals within communities, and an individual's age, gender, and social hierarchy. In contrast to the fluctuating cycles of nature, the unchanging, accurate measurement is a human invention. In our society, this artificial time has taken on such dominance that we frequently refer to it as time in and of itself, as though there were no other times [68]. In the reality of the physical world, in real-time dynamics, neither the objective world is static nor even our psycho-somatic physical Self, which comprises many motions throughout the body.

In contrast to reversibility from the Physics approach, in terms of the social lives of humans, we can say that certain things happen repeatedly, seemingly invariantly, and irreversibly. Instead, time is created, entailed, and enacted in cultural life; time is involved in sequence, duration, intensity, passage, and irreversible direction. It also generates a new past and future [68].

"The meaning of time, on the other hand, is encapsulated neither in the oscillations nor the number system."

The laws of classical mechanics govern the operation of the clock. A pendulum monitors time. However, the oscillations and the number system need to capture the essence of time [68] adequately. In the biological setting of the experimental set-up, the electric signals in different body parts are measurable, like EEG, MEG, ECG, ECOG, EOCG, EMG, EGG, Polysomnography corresponding to different motions within ourselves albeit in the current 24 hours a day scale. In this setting, we view time perception for the consciousness study as it justifies delving deeper apart from the psychological or neuroscientific approach of time as a machine-based usable tool to understand computational or processing capabilities of brain functioning.

3.2 Psychological Research on Time Perception

Significant works in the psychological paradigm of time perception have been done since Gibbon's scalar expectation theory of memory timing on animatic beings about the temporal perception of information processing [69]. Church studied it is preferable to look at how animals perform in a variety of processes with varying qualities in order to characterize the properties of functioning animal parts

rather than procedure proper- ties. Three procedures have been used in the majority of research conducted in our lab: the bisection, peak, and temporal generalization procedures [70]. Hinze, in his Real- time perception, perceptual mechanisms depict a complete chronology at any given moment rather than just one particular time. In this timeline, reconstructive mechanisms change how we see things after the fact when predictions do not come true, and predictive systems make predictions ahead of time to make up for delays in sensory input [71]. Thones et al. studied rigged (accelerated or decelerated) external clocks can effectively induce altered time perception; second, most participants are oblivious to these clock-speed manipulations; and third, several psychological, cognitive, behavioral, and physiological variables can be impacted, such as pain perception, hunger, and weariness [72]. Sandrine et al., in a study, used the Beck Depression Inventory (BDI) to measure each participant's depression symptoms in order to look at how changes in time perception relate to those symptoms. In a temporal bisection test, the participants had to classify a signal duration ranging from 400 to 1600 ms as long or short. Accord- ing to the findings, there was a change in the bisection function towards the right, and the depressive participants had a more significant point of subjective equality than the non-depressive participants [73]. Research, both phenomenological and experimental, demonstrates that individuals with depression experience time flow more slowly and tend to overestimate durations of time. Those with depression often exhibit a greater preoccupation with previous experiences and a decreased emphasis on current and future events when compared to those in control conditions [74]. Time perception from a psychological perspective is different in different states. In an altered state, it slows down, whereas in a manic state, it speeds up compared to the expected timing. All these studies are more or less based on time, i.e., the machine as a physical keeper of time and their corresponding neurobiological impacts. It is noteworthy that perceiving time is unlike physical world stimulant-driven objective assessment. While the archaeological endeavor of time perception delves into cultural signatures that races across the world leave behind during various historical periods, criticizing time perception through the lens of the machine is remarkable to distinguish the generic concept that we, over generations, keep bearing in the modern world.

3.3 Spirituality

Like consciousness, a definition is far from agreement, though it is a part of life; even enlightened souls describe the whole life as Yoga. In Indian culture and tradition, Yoga and spirituality have existed since ancient times.

‘The way forward is to think of spirituality in terms of its relevance and importance to individuals in their everyday existence’ (McSherry, 2000).

'Understanding these meanings without rendering them meaningless through de- contextualized analysis can provide a seedbed for systematic study and the further development of practice and theory.

Common meanings become apparent when narrative accounts of diverse clinical situations are given with the intentions, content, and meanings intact.' Benner (1984)

Here, inevitably, justifiable rationality surfaces for including the context of spirituality. However, similar to the difficulty in defining consciousness, spirituality also arises in this case. Wixwat et al., in a paper 'Being Spiritual but not Religious' noted, in a qualitative investigation into the common understanding of spirituality, the participants linked spirituality to God and activities meant to foster a relationship with him, such as formal religion and unique, mystical experiences (for those open to such experiences). Participants in another study provided a similar definition of spirituality, with 36% defining it as the sense of being connected to God, Christ, a higher power, transcendent reality, or nature, and another 34% defining it in terms of belief and faith in a way that was generally consistent with theism [75].

Margot Grey (1984) and others have reported commonalities in spiritual experiences and NDE states. Though disconnected consciousness studies through NDE have gained momentum, we need to be mindful that during NDE state flat EEG reading [76], [77], [78], albeit vivid memories described by the subjects are worth inculcating. Reports of two instances of NDE are tempting to without mentioning. A 30-year-old woman suffered a head injury that caused her to a comatose state, which doctors described as a Glasgow coma scale score of E1 V1 M2, perceived OM as the apparition of light during NDE [79]. In another report, Eben Alexander, a neurosurgeon, in his book *Proof of Heaven* during the NDE state, experienced perceiving OM and described it as omniscient and omnipotent, something beyond description [80]. Peyton, in the post-NDE transformation narrative, stated, "...I entered the same transcendent state of consciousness that I had entered a year before"[81]. At this juncture, it is perhaps not wholly unworthy to mention that a brain deprived of oxygen causes out-of-body (OBE) experiences [82]. Olaf Blanke elucidated that this aspect is not only reported in NDE; however, OBE in pilot and fighter aircraft also reportedly mentioned similar experiences [83]. OBE experience is neither new nor uncommon in spiritual experiences.

The fourth state is actually as vast expanses of spiritual extent historically ascribed. Therefore, without including this state, the quest for consciousness remains open without being closed. Contemplating the fourth state in one form or other for consciousness studies did not remain fully outside the area of inculcating, rather. Bernard Baars thoughtfully opined about silent consciousness. However, the consciousness quest remained primarily about the awakening states [84]. Paoletti Sphere model of consciousness entails analysis of self-awareness and consciousness using the neuro-phenomenological theoretical framework where the Focused Attention, Open Monitoring, and Non-Dual Meditation kinds hierarchical organization is mirrored in the hierarchy of the three states of the Self [41]. In both of these, the Vedic ascription of the fourth state is the critical fabric of stipulation. However, in the broader scope, time perception and spirituality-based endeavors are still far from the theory of consciousness and

subsequent testing mechanism holistically. In the course of perceiving time through any earthly object-based regime, it may not be conducive to actually perceiving time on a real-time basis. Sensory input-based stimulant use is unlikely to be beneficial to a great extent. Inner visual and audible perception is much more intense and accurate than the corresponding sensory input led representation of the objective world, only known to those who experienced in within.

4. Discussion:

In light of the above, time, whatever way we define physical, chronological, biological, geological, psychological, and archaeological, being a candidate for crucial aspects of consciousness does not appear to be unrelated; hence, the rationality surfaces of time perception in consciousness study.

As Stoddart postulated, "Without sensation, therefore, consciousness cannot exist; the essential basis of consciousness is sensation" [14]. The contemporary consciousness studies, by and large, make this the bottom line, albeit the unconscious part is also considered. This is a crucial area where Vedantic ascription marked a distinct demarcation without putting up a complete stop. To realize consciousness, the state beyond deep sleep, therefore, remains outside the domain of contemporary consciousness study.

Spirituality, often around Yoga and meditation throughout the ages, has extensively been put up for research. However, we do not intend to encroach into that domain. As Lifshitz et al. state, "One of the enduring puzzles in ethnography and history is that everywhere in the world we find spiritual experts—shamans, priests, sorcerers, and sadhus—and yet nowhere in the world is there a society in which all are experts. How do some people come to have vivid spiritual experiences, but not others?" Our emphasis is to address the recent consciousness study that invoked through hard problems of 'how we experience' is not an isolated regime from the spiritual state, i.e., the fourth state. However, this problem is solved through many theories of consciousness approaches through stimulant input only. We contend that the experimental regime must be broadened to accommodate beyond the deep sleep, which does not at all have characteristics of lesser awareness vis-à-vis lesser wakefulness. It is a different realm, having its pervasiveness, transcendence, and dimensions different from the objective world three dimension + time axes. The most challenging part is that people rarely have access to this state, which makes it most limiting to adopting a coherent approach. Even in the regime of hypothetically deductive approach, this happens to be made out of including in the research domain.

The earliest psychophysical researchers, like Fechner, Vierordt, conducted their experiments on themselves for their respective areas of interest. However, it was quickly realized that random control trials were required, and the stimuli should be presented in random order. A core reason surfaced then: according to researchers in Germany and the USA, expectations for the following distance may skew the perception of distances [85]. How is the idea of the interviewers or complacent person who

experienced the fourth state with self-subjective experience scoped into the research experiment and the possibility of bias?

Is there any scope for the level of consciousness and contents of consciousness graph in Fig 1 to include the state of spirituality? It is noteworthy that Fig 2 did not keep the near-death state excluded in the three-dimensional representation.

Neuro-instruments-based probes or experiments are mostly stimulants and subsequently capture the reading. Apart from traditional stimulants, recent virtual and naturalistic stimulants are also being widely used for behavioral neuroscience in natural settings. However, designing innovative cognitive experiments encompassing time perception and carefully creating an endeavor for overt attention is conducive to simulating the background for the consciousness probe. It is worth considering why designing cognitive experiments for understanding consciousness should not be framed around the fourth state.

It would not be irrelevant to mention that objective physical world constants are primarily of minimal values in magnitude that this universe is eventually made of on a cosmic scale. Extending a small quantity of imagination, should consciousness become discoverable using this quest at some point, what kind of magnitude could it be, small like these constants or astronomical figures comparable with the speed of light?

Reaching consciousness therefore, introspection of when it transpired historically leads to how a plausible analytical or experimental endeavor should be framed given the complexity and interdisciplinary domains of intersection. Modern civilization has methodically progressed with the reference framing of clock time which historically depended upon as life by the rotation of Earth i.e., time as length of day among other things. However, consciousness is a fundamental characteristic, so it is paramount to take stock of how other disciplines view time perception. A synchronization of internal and external time is essential. The approach to the blurred boundary between intelligence i.e., information processing capability and consciousness compounds the complexity of problems since the concept of self is not necessarily limited to the neuroscientific objective of social grouping; the biological paradigm of the immunity system of defense is irrefutable to ignore. We must realize how the body organically functions and comprises also our physical and vital self. Therefore, the approach to understanding Consciousness by its merit needs to be widened without limiting it to a reductionist approach.

5. In the End

Schrodinger, who stirred a perennial whirl of thoughts with his hypothetical cat experiment, in his book (1944) "What is Life" [15], contemplates whether quantum mechanics related to life biological events

and the possible extent thereof, in the ‘Epilogue on determinism and Freewill’ surmised the below context:

“The earliest records, to my knowledge, date back some 2,500 years or more. From the early great Upanishads, the recognition ATHMAN = BRAHMAN (the personal self-equals, the omnipresent, all-comprehending eternal Self) was in Indian thought considered, far from being blasphemous, to represent the quintessence of deepest insight into the happenings of the world. The striving of all the scholars of Vedanta was, after having learned to pronounce with their lips, really to assimilate in their minds this grandest of all thoughts.”

The enormity of the philosophical width and infiniteness of the spiritual arena is undoubtedly outside the purview of this paper. However, it discussed various features of the study of consciousness that span many domains, i.e., interdisciplinary areas. Moreover, this paper argues that the fourth state, which is indeed attainable in self-spiritual subjective experience as reported by enormous enlightened receptacles, is a crucial aspect that must be brought into the research domain should the consciousness quest aimed at discovering the telltale signature [11]. A hypothesis was only considered vital if thorough research did not disprove it, not if there was evidence to the contrary [86]. Hypothesizing objectively identifiable paradigm without broadening the scope and excluding the fourth state will unlikely reach a breakeven point since this fourth state is not at all mere scripts embedded in ancient ages literature but rather the transcendental state of primordial infinitude, the objective assessment under the pursuit of scientific prowess yet to address. These are Truth subjectively attainable and by its own merit. Traditionally, seekers of Truth tend to keep this kind of experience within their ecstatic receptacle except seldom describes that if someone could be able to support themselves aware in a state of inner world journey such as sleep, at the intervening moment of reaching a threshold something magical happens which might be extremely difficult to express except the more than pleasant incomparable nature of this subjective experience of transcendence. A change in otherwise normal consciousness that prevails in daily and ordinary life perhaps waits to be self-discovered. Another world, different from the typical subjective experience, exists beyond the sensory stimulus input-driven objective world that transpired as a self-proof to the complacent seekers. Like all other states of consciousness, dreams, sleep, disorders, and even near-death experiences (NDE) are very much in the research domain; excluding spirituality in the broadness of scope of consciousness study is incomplete, though some researchers tend to include it, is like leaving a critical piece out of the most baffling oldest quest in humanity. Nonetheless, perceiving time and utilizing overtly covert attention in the research domain is a crucial aspect of reaching this gateway.

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360 Virtual Reality assisted Mantra Meditation

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Durgesh Ameta^{1,2}, Ankita Garg¹, Laxmidhar Behera¹, Varun Dutt¹

¹Indian Knowledge System and Mental Health Applications(IKSMHA) Centre, Indian Institute of Technology Mandi, Kamand, Mandi, India

² Institute for Science and Spirituality, Delhi, India

Abstract:

Meditation and other similar practice help improve emotional stability, awareness, and attention. The practitioners of such activities may benefit from virtual reality (VR) as they might struggle with attention or concentration. Among numerous investigations into the suitability of VR for meditation, very few have attempted to assess the efficiency of VR on Audible mantram repetition (AuMR). In this study, we created two groups, test and control, each comprising ten members. The test group undertook a ten-minute session of mantram meditation, while the control group remained idle. All participants in both groups experienced the identical immersive VR environment in 360 degrees. Electroencephalogram (EEG) and heart rate variability (HRV) measurements, along with the administration of questionnaires and cognitive assessments (Stroop task and N-back), were conducted prior to and following the intervention in both groups. This study aimed to evaluate changes in participants' mental states and cognitive capacities. Paired t-test results showed that the DASS parameters were significantly reduced, while the HRV parameters, EEG features and accuracy in the N-back test substantially increased in the test group as compared with the control group. In addition, for PANAS, positive affect increased and negative affect showed reduction which was statistically significant for the experiment group. This research provides noteworthy effective data and supports the feasibility of conducting a larger randomized study to evaluate the potential of AuMR in clinical environments.

Keywords: physiological signals · mantra meditation · Human computer interface · 360 Virtual reality.

1 Introduction

The act of meditation cultivates emotional stability, attentiveness, and heightened awareness among individuals [15]. However, sustaining concentration during meditation demands intentional exertion and may pose challenges, especially for beginners who require extra cognitive resources to manage their self-regulation abilities [19]. There are several potential challenges associated with meditation,

such as boredom and disturbing experiences as described by Anderson et al. [21]. Research has explored the integration of digital technology to overcome the challenges in meditation practices [35]. For instance, recent suggestions encourage the use of virtual reality (VR) to foster mindfulness [24]. VR technologies have the potential to effectively address the aforementioned difficulties by presenting an immersive, a captivating, well-managed visual and audio environment, essentially creating a conducive space for meditation [7]. This environment effectively shifts attention away from the immediate physical surroundings in the actual world. The concept of "virtual reality" (VR) signifies the utilization of a head-mounted display to generate an audiovisual, 360-degree interactive virtual environment for the user's experience [28]. Numerous studies have examined how VR-supported mindfulness techniques affect mental health [5]. The term "mindfulness" is commonly employed to encompass a broad spectrum of behaviors, methodologies, and characteristics [40]. To the author's knowledge, no studies on the relationship between mindfulness and virtual technology have examined how VR environments may affect mantra-based meditation. This research is significant given the widespread adoption of mantra-based meditation as a contemplative practice [31, 6]. Mantra-based meditation involves chanting a "mantra"—a sound, word, or phrase—during the meditation session, either aloud or silently [46]. The participants in test group chanted the specific Maha-Mantra, "Hare Krishna, Hare Krishna, Krishna Krishna, Hare Hare, Hare Rama, Hare Rama, Rama Rama, Hare Hare" during the study [46, 14]. We hypothesize that incorporating VR technology into AuMR will yield enhancement in the general state of mind and cognitive capacities of the practitioners. To gauge these alterations, we employed the following evaluative frameworks: HRV parameters, the power of temporal theta and frontal alpha waves derived from EEG signals, the reaction times and accuracy of Stroop and n-back psychometric tests, and reductions in psychological elements like anxiety, depression, and stress. Positive and negative emotional states of mind through questionnaires [29, 43, 3, 27, 23, 34, 22]. The mantra namely, Hare Krishna Mantram (HKM) has demonstrated its potential in diminishing tension and dealing with preclinical depression [31]. The act of mantra chanting has been found to enhance the frequency domain HRV parameters, particularly the ratio of $\ln LF / \ln HF$, which can be acknowledged as an indicator of mental well-being [26]. Notably, there was an observed enhancement in frontal and temporal theta activities, both of which are associated with increased focus and improved performance in working memory tasks, subsequent to the act of chanting [41]. Furthermore, a discernible augmentation in attention and working memory was corroborated through improved outcomes in the N-back and Stroop psychometric assessments [32].

Layout of the paper: The background is provided in Section II after the introduction. The methodology is covered in Section III, the results in Section IV, and the discussion and conclusions are presented in Section V.

2 Background

Recently, there has been a lot of attention focused on the use of digital tools to support mindfulness practices [25]. Notably, smartphone applications now offer user guided audio exercises, promoting habit formation and active engagement with mindfulness [30, 11]. Simultaneously, web-based interventions have emerged to enhance mindfulness skills [39, 42]. Despite the enhanced usability, these solutions provide for mindfulness-based therapies, and studies have revealed that adherence to interventions delivered through the Internet and mobile devices tends to be relatively low [37], suggesting a potential lack of sustained engagement [20].

A recent proposition in this domain has been the use of Virtual Reality (VR) to bolster mindfulness [13, 8]. This approach capitalizes on VR's capacity to provide an immersive, captivating, and controlled visual and auditory environment, fostering a conducive space for mindfulness practice [25, 9, 10]. Importantly, this technology can effectively mitigate the challenges stemming from environmental distractions. By shifting focus away from real-world surroundings, VR technology offers a solution to address these issues. The utilization of headgear and display apparatus to offer users a completely interactive audio-visual virtual environment (VE) is denoted as "virtual reality" (VR) [36, 16]. Although a range of virtual environment formats can be presented, VR headsets can induce users to experience a heightened illusion that they are present in the virtual environment. [16, 33, 45].

To the best of our knowledge, no investigation has been conducted on the impact of various Virtual Reality (VR) environments on this specific activity. The term "Mantram" originates from the Sanskrit words "Manas", signifying "Mind", and "Tra", signifying "That which delivers". This pertains to a set of phrases that, when spoken mindfully, possess the potential to alleviate daily stress.

According to Wolf and Abell, repeating the Hare Krishna Mantra (HKM) leads to a reduction in stress and subclinical depression [46]. In the frequency domain, Damerla et al.[14] observed increased HRV characteristics, specifically the $\ln\text{LF}/\ln\text{HF}$ ratio, after meditation. Similarly, significant enhancements in the PSD of temporal theta and frontal alpha waves following mantra meditation have also been reported [32]. Additionally, cognitive capacity improved following mantra meditation. We used the same experimental guiding principle to determine whether these results were applicable in a Virtual Environment (VE).

3 Method

3.1 Participants

Twenty people, between the ages of 18 and 20 years (mean age = 18.5 years, standard deviation = 1.8 years), including twelve males and eight females, voluntarily participated in this study. The entire group of participants included undergraduate students with a background in science, none of them had any visual or mental impairments. The participants were randomly allocated to groups. Subsequently, from the initial allocation, seven males and three females were assigned to the experimental group,

while the control group consisted of five males and five females. This study was approved by the Ethical Committee of the Indian Institute of Technology, Mandi. Before the commencement of the experiment, the participants filled in the consent form as they agreed to participate in the study.

3.2 Omnidirectional(360 VR) Video

Fig. 1 illustrates the video's depiction of a garden scene captured at a botanical garden close to the Himalayan foothills. The video was recorded using an Insta360 ONE Xtm camera with a 4K resolution [1]. To provide the impression that the subject of the shot was sitting in meditation position, the camera was positioned at a height of 0.6 meters.



Fig. 1. Locations selected for video recording in a 360 VR format. The figure shows a VE, where subjects participate in chanting alongside three other meditators.

3.3 Self Reported Questionnaires

The research utilized the subsequent questionnaires to gather data:

Positive and Negative Affect Schedule (PANAS) The Positive and Negative Affect Schedule (PANAS): is a widely used tool for assessing mood and emotions. Comprising 20 items, this concise scale includes 10 items gauging positive affect (such as sentiments of inspiration or joy) and additional 10 items assessing negative affect (such as feelings of distress or fear). Participants provide ratings for each item on a five-point Likert scale, ranging from 1 ('not at all or hardly') to 5 ('very high'). The Likert scale is used to assess the degree to which individuals have encountered these emotions within a designated period. The PANAS is structured to appraise effects across diverse contexts, including the broader, year, week, day, and preceding day [43].

Depression Anxiety Stress Scale-21 (DASS-21): Depression, anxiety, and stress are three associated emotional states evaluated by the questionnaire. Responses are offered on a Likert scale, with seven graded options ranging from 0 to 3. The scale's anchors range from "Did not apply to me at all" (which receives a score of 0) to "Applied to me very much or most of the time" (which receives a score of 3). The sums of the individual item scores are aggregated to compute the scores for anxiety, depression,

and stress. To obtain a overall score, the subscale scores are multiplied by two, as the DASS-21 is a condensed version of the initial 42 items of DASS score [3].

3.4 Psychometric Tests

Performance was evaluated using the Psychology Experiment Building Language (PEBL) of Version 0.13 for the N-Back and Color Stroop tasks [23].

N-Back test: Working memory and its capabilities are assessed using the N- back assessment, a method that is frequently used in the domains of cognitive neuroscience and psychology [18]. This test measures a particular aspect of work- ing memory by repeatedly presenting letters and asking for recall-based answers. Determine whether the letter you are seeing now matches the one you saw N tri- als ago. N can be 1, 2, or 3. Participants are shown a series of individual letters, one after the other. A fixation cross was shown in place of each letter during the interstimulus interval, which was followed by a 500 millisecond period dur- ing which each letter was visible. Importantly, 33% of the letters functioned as targets in all conditions. The analysis employed precision in generating accurate responses as the performance gauge.

Stroop's Test: The Stroop's Test evaluates an individual's ability to handle employ selective attention and conflicting information. During the task, partic- ipants were presented with the color names displayed in different colored inks. It was their responsibility to swiftly identify the ink color without being swayed by the word's semantic connotation. Three keyboard keys, each correspond to a different hue, were where participants' fingertips were put. Participants were introduced to color-to-key mapping during the pre-game phase.

The main test consisted of 144 trials, encompassing 48 stimuli for each con- gruence condition. In each trial, words were randomly displayed for 150 millisec- onds, succeeded by a 1,750-millisecond blank screen interval. Participants were instructed to accurately and rapidly press the key corresponding to the ink color of the stimulus. The time taken to complete the task and the frequency of er- rors committed shed light on an individual's aptitude to focus on task-relevant information while effectively suppressing the automated process of irrelevant information.

3.5 Physiological Measures:

Electroencephalogram (EEG): For post-meditation and pre-meditation EEG signal acquisition, the Muse™ headband was employed [38]. The EEG data underwent multiple preprocessing stages, which encompassed baseline filtering, bandpass filtering and notch filtering. A notch filter was implemented to elimi- nate the common 50 Hz power line of the interference that is often present in the EEG recordings. To confine the resulting data to the frequency range of 0.1 – 60 Hz, a bandpass filter was

applied, effectively attenuating frequencies outside this range. This multi-step preprocessing procedure prepares the EEG data for subsequent analysis and interpretation.

After applying the filter methods, a (PSD) Power Spectral Density analysis was conducted to assess the method that EEG power is distributed throughout frequency ranges [34]. This study concentrated on the frontal alpha and temporal theta frequency bands. Welch's Periodogram method was used to compute the above PSD [44], which is reliant on Fast Fourier Transformation (FFT) [12]. This evaluation offers an understanding of the dispersion of EEG power within the designated frequency ranges.

Heart Rate Variability: EM Wave Pro apparatus was used to capture the HRV signals from participants [17]. The Frequency Domain Analysis of HRV was chosen to see changes in heart rate due to the meditation. The Welch's periodogram method was used to estimate the power spectral density (PSD) for this analysis [44] based on Fast Fourier Transformation [12].

Given a frequency spectrum's PSD denoted as $p(k)$, the calculation of the ratio LF/HF , and the absolute power of LF , HF is performed as follows:

$$aLF = \sum_{k=0.04}^{k=0.15} p(k) \quad (1)$$

$$aHF = \sum_{k=0.15}^{k=0.40} p(k) \quad (2)$$

$$aTotal = \sum_{k=0}^{k=0.40} p(k) \quad (3)$$

$$pLF = \frac{aLF}{aTotal} 100 \quad (4)$$

$$pHF = \frac{aHF}{aTotal} 100 \quad (5)$$

$$LF/HF = \frac{aLF}{aHF} 100 \quad (6)$$

Here, aLF stands for absolute LF power (0.04-0.15 Hz), aHF for absolute HF power (0.15-0.40), and pHF and pLF for relative HF and LF power, respectively.

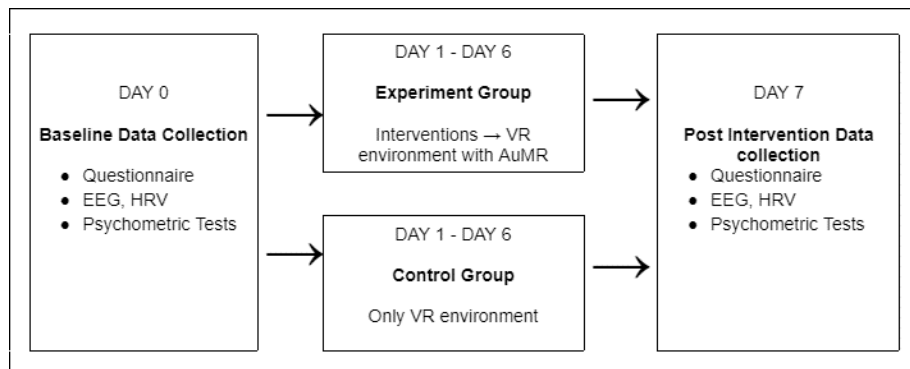


Fig. 2. Experimental design

3.6 Experimental Procedure

Every participant within each group underwent a baseline assessment on the first day, during which they completed a consent form, the PANAS questionnaire, and the DASS 21 questionnaire. The Stroop and N-back tasks were then performed by participants. Finally, over the course of a 5-minute interval, HRV and EEG signals were captured. Figure 2 illustrates the study's experimental layout.

All members of the intervention group underwent 10 minutes of mantra meditation over the course of the following five days, during which they repeated the "Maha Mantra" while watching 360 VR video in the Oculus VR headset [2]. The control group refrained from mantra chanting, they were solely exposed to the VR environment. Figure 1 illustrates how the VR environment depicted a garden scene, where people performed AuMR seated on the grass. Data collection for the post-experiment was completed for both groups on the seventh day. Prior to taking the N-back and Stroop tests, participants completed the DASS-21 and PANAS questionnaires. Then, for a 5-minute period, HRV and EEG signals were captured.

3.7 Dependent Variables

The study's dependent variables consisted of eleven factors, encompassing data from questionnaires, psychological tests, EEG recordings, and HRV analyses. These variables encompassed positive affect, negative affect, depression, anxiety and stress as measured by the survey questionnaire. Additionally, frequency domain parameters such as LF, HF, and LF/HF were added through HRV analysis. Accuracy was a dependent variable from the psychometric test. The temporal theta band power and frontal alpha band power were the dependent variables in the EEG analysis.

3.8 Hypothesis

Building upon prior research, our hypothesis posits that engaging in chanting within a virtual reality (VR) environment will lead to significant improvements in overall mental health and cognitive functioning for practitioners [46, 14]. This expectation aligns with existing studies that have indicated a positive relationship between VR-based chanting and various measures of well-being, including heart rate variability, EEG signals' theta power, performance in cognitive tests like N-back and Stroop, as well as reduced levels of anxiety, stress, and depression [3, 27, 23].

3.9 Data Analysis

The post-intervention and pre-intervention scores of the EEG features, HRV, Stroop, N-back, DASS and PANAS are compared using paired T-test analyses to assess the hypotheses. Data analysis is carried out using SPSS 21.0 [4]. Individually conducted repeated measures of Paired T-tests revealed a significant distinction between the measurements taken before and after the intervention.

4 Results

4.1 Self-reported Questionnaires

Positive and Negative Affect Schedule (PANAS) Figure 6 shows the changes in PANAS parameters, the positive affect increased ($t(10) = 3.36, p < 0.05$), and negative affect decreased ($t(10) = -5.80, p < 0.01$) in the test group.

Depression, Anxiety, and Stress Scale (DASS-21) Decrease in depression, anxiety, and stress levels is observed for both groups while the results were significant in the intervention group, for all three parameters as compared to the control group as shown in figure 6. After applying paired t-test, stress ($t(10) = -2.704$), anxiety ($t(10) = -4.5$), and depression ($t(10) = -2.084$), where $p < 0.05$ for all the three variables.

4.2 Physiological Measures

HRV Figure 4 shows changes in HRV frequency domain parameters, i.e. HF, LF and LF/HF and these parameters demonstrated statistically significant improvement for the intervention group ($p < 0.05$). According to the results, LF ($t(10) = 4.103$), HF ($t(10) = 5.528$) and LF/HF ratio is ($t(10) = 2.08$).

EEG Figure 3 indicates a significant rise in frontal alpha ($t(10) = 5.11, p < 0.01$), and temporal theta ($t(10) = 2.37, p < 0.05$), which is consistent with prior findings.

4.3 Psychometric Tests

N-back test Considerable improvement in the working memory test, after the meditation, is observed. Figure 5 indicates the rise in the percentage of accurately answered trials for the 1-back task ($t(10) = -2.613, p < 0.05$) and 2-back test ($t(10) = -3.039, p < 0.05$).

Stroop test We assumed that after the meditation session, there would be an increase in accuracy in the Stroop task conducted after the intervention. Figure 5 illustrates that accuracy has indeed improved for both groups. Nevertheless, these changes lack statistical significance.

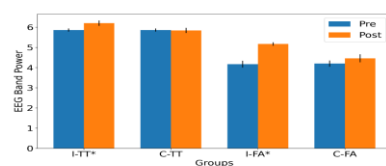


Fig.3.Bar Graph of EEG Band Power. Abbreviations: I-TT,I-FA, Intervention Group Temporal Theta and Frontal Alpha; C-TT,C-FA, Control Group Temporal Theta and Frontal Alpha.

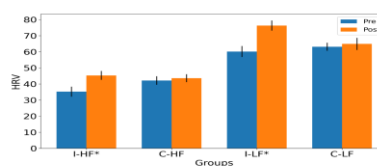


Fig.4.Bar Graph of HRV features. Abbreviations: HF, High Frequency; LF, Low Frequency; I-HF,I-LF, Intervention Group HF and LF; C-HF,C-LF, Control Group HF and LF.

5 Discussion and Conclusion

Meditation is healthy for a person, according to numerous research studies. But it can be challenging to do so, especially for beginners who need more cognitive capabilities to govern themselves. Various studies have shown that VR enhances

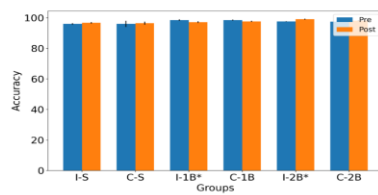


Fig.5.Bar Graph of Accuracy of Psychometric Tests. Abbreviations: I-S, I-1B, I-2B, Intervention Group Stroop Test, 1-Back Test and 2-Back Test Accuracy; C-S, C-1B, C-2B, Control Group Stroop Test, 1-Back Test and 2-Back Test Accuracy

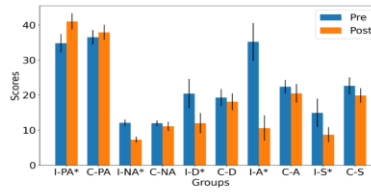


Fig.6.Bar Graph of Scores of Questionnaires. Abbreviations: I-PA, I-NA, I-D, I-A, I-S Intervention Group Positive Affects, Negative Affects, Depression, Anxiety and Stress Scores; C-PA, C-NA, C-D, C-A, C-S Control Group Positive Affects, Negative Affects, Depression, Anxiety and Stress Scores

meditation quality, but no similar research has been conducted for AuMR, a popular form of meditation used in India. The focus of the study is to address this literature gap. The results unveiled significant improvement in the result of the eleven dependent variables, which encompassed negative and positive affect from PANAS, temporal theta and frontal alpha band power through EEG, anxiety, stress and depression as measured by DASS-21, accuracy in N-back and Stroop tests, as well as HRV features HF, LF, and LF/HF ratio, among the post- intervention and pre-intervention scores within the test group. Positive effects increased while negative effects decreased on the self-reported questionnaire. We also noted a reduction in the DASS-21 scores for depression, anxiety and stress scales. In line with the findings reported by Damerla et al.[14], post-meditation, the HRV parameters in frequency domain (lnLF/lnHF ratio) were found to significantly increase. There were two groups of participants in this study: those who participated in the experiment group chanted the Maha Mantra while viewing a 360-degree immersive film of a garden, and those who viewed the identical VR environment without any tasks. A rise in EEG (Temporal Theta, Frontal Alpha) [40] and HRV (LF/HF, HF, LF) [5] is observed for the test group, this consistency aligns with previous research outcomes. By utilizing the N-back test, we identified improved cognitive capacities encompassing working memory. Although there was a rise in accuracy after the intervention in the Stroop task, this increase did not achieve statistical significance, possibly due to the limited duration of the experiment. Overall, our findings harmonize with the existing literature on mantra meditation. This observation corresponds with earlier research [46, 14], which indicated that when the Hare Krishna Mantram (HKM) was audibly chanted, individuals experienced reductions in stress levels and undiagnosed depression, coupled with notable enhancements in HRV parameters within the frequency domain. These outcomes substantiate our hypothesis that the practice of mantra meditation in conjunction with VR headset usage has the potential to positively enhance both mental and cognitive well-being.

This study is constrained by a smaller participant pool and a relatively short intervention duration. To yield more dependable outcomes, a larger sample size and a more extended intervention period could be employed. Additionally, the study's limited scope is evidenced by the provision of only

one type of environment, a garden. To enhance user experience, diverse serene settings could be incorporated into the VR environment. Future investigations could address these limitations to produce more favorable results.

Furthermore, a more comprehensive analysis could involve a group practicing mantram meditation without VR, enabling a comparison with the efficacy of mantram meditation in a VR environment. These concepts form the basis for the upcoming stages of our research endeavor investigating the benefits of Mantram Meditation.

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Role of Panch kosh tools in holistic health care assessment analysis and impact of Intervention based on Panch Kosh guidelines.

Rajesh Kadam¹, Dr. Ajay Sankhe²

¹Bhaktivedanta Hospital and Research Institute, Department of Spiritual care, HOD

²Bhaktivedanta Hospital and Research Institute, Director

Abstract:

Background: An Individual is more than just the Physical Body. There are five layers or dimensions. The physical sheath (Annamaya Kosh) consists of gross physical body and the senses. The five organs of perception (jnanendriyas) viz. eyes, ears, nose, tongue, and skin and the five organs of action (Karmendriyas) viz. hands, rectum, legs, belly, genitals are a part of it. The energy sheath (Pranmaya Kosh) consists of five life airs, (the five pranas flowing through the astral tubes called as the 'Nadis') which ensures the physiological functions (Perception, Digestion, Circulation, Excretion and Thought process). The mental sheath (Manomaya Kosh) consists of the mind which does the psychological function of thinking, feeling and willing. The conscience sheath (Vijnanmaya Kosh) consists of intelligence which does the function of discrimination and decision making. The Individual determinant sheath (Anandmaya Kosh) consists of false ego, which gives identity to the individual to enjoy that position identifying with the body. When all the sheaths are purified an individual becomes healthy, skilful, sensitive, conscientious, and grateful. Though knowing the spirituality of a person is impossible, yet through these five parameters one gets the spiritual indicators of the five dimensions of holistic health namely physical, physiological, psychological, conscientious, and individual determinant.

Annamaya Kosh: Favourable Factors: Satvic diet, Appropriate Sleep, Cleanliness, Exercise, Healthy Austerity Unfavourable factors: Laziness, Conflicts, Addiction, Malnutrition, Starvation, Disease, Accident, Unrestricted desires. Intervention: Lacto-Vegetarian Sanctified Diet, No Intoxication, Surya Namaskar, Quality sleep, Hand Hygiene

Pranmaya Kosh: Favourable Factors: Sleeping early, Rising early, Sports, Singing, Pranayaam Unfavourable factors: Too much or too less Endeavours, Fear, lamentation, Uncontrolled anger, Uncleanliness, Indiscipline, Intervention: Pranayaam, Sleeping at 9pm (7hrs sleep minimum), Punctual Meals, Recreational Sport

Manomaya Kosh: Favourable Factors: Mantra meditation, Art of Acceptance, Obedience, humility, simplicity, Forgiveness Unfavourable factors: Defeat, loneliness, bad company, defamation, fear of danger, family conflict, insomnia, greed, illusion, enmity, criticism, poverty, over entertainment Interventions: Sound Meditation (Mantra, Indian Classical Music) , Tratak, Practicing Non-Violent communication

Vijnanmaya Kosh: Favourable Factors: Hankering for Meditation, taste for Hearing, inquisitiveness, reading, learning &

discussing spirituality, cooperation, perseverance, experimenting, connection with wise men. Unfavourable factors: To insult or get affected by insult, be arrogant or get affected by arrogance, to disobey fanaticism, too much Strictness, Suspicion, Pride, over endeavour, agitation, blind faith, frog mentality (denying or limiting the existence of truth which is beyond the capacity of one's senses) Interventions: Reading scientific books on spiritual technology, Listening to scientific discourses, Regular self- introspection of faith, desires, behaviours, Identifying negative thoughts, feelings, beliefs, and reforming by discussion with expert counsellors. Anandmaya Kosh: Favourable Factors: Seeking with in (Love for the Absolute), receiving guidance from spiritual teacher, Selfless service to all with God in the centre. Unfavourable factors: Hypocritical associates, Praise seeking, Illusion, Illicit actions, deviation from the purpose of life, boasting oneself in front of juniors, offence towards righteous men, to be affected by victory or defeat. Interventions: Practicing gratefulness, Serving selflessly, Working for a higher purpose. Methodology: Questionnaire with five sub-sets to assess the five parameters of the individual's health was developed, validated (population and expert validation) and accordingly data is captured. Results: After assessing individuals through the questionnaire, the shortcomings in their lifestyle for a holistic health progress at the level of body, mind & soul could be identified and the interventions according to the Panch kosh guidelines were administered which evidenced significant improvement in data parameters. Conclusion: Panch kosh indicators can assess holistic health of individuals and serve as guidelines for appropriate interventions to achieve holistic health.

Closed-loop auditory neuromodulation during sleep for enhancing slow wave – spindle coupling in schizophrenia: A pilot study.

Chakraborty Deepankan¹, Krishnan Ananda², Naaz Safoora³, Venugopal Rahul³ Kumar Gulshan³, Sasidharan Arun³, Marigowda Vrinda⁴, Govindaraj Ramajayam³, P N Ravindra³, M Kutty Bindu³.

¹Department of Cognitive Neuroscience, JSS Academy of Higher Education & Research, Mysuru, India

²Jiwaji University, Gwalior, Madhya Pradesh, India

³Centre for Consciousness Studies, Department of Neurophysiology, NIMHANS, Bengaluru, Karnataka, India

⁴Axxonet Brain Research Laboratory (ABRL), Axxonet System Technologies Private Limited, Bengaluru, India

Abstract:

BACKGROUND: Closed-loop stimulation paradigm represents a method to control the external environment using neurophysiological data and provide feedback to subjects, thereby influencing their brain activities (1). Researchers have utilized closed-loop paradigm systems in many domains such as deep brain stimulation (DBS) systems to alleviate dyskinesia and paralysis resulting from Parkinson's disease (2,3) and feedback systems to improve usability of neuroprosthetic devices (4,5). Here we explored the feasibility of using closed-loop EEG -based auditory stimulation as a tool to improve coupling between two sleep-related brain oscillations (sleep spindles and slow waves) in patients with Schizophrenia (SCZ). Research on sleep spindles and slow waves in SCZ have predominantly concentrated on examination of the associations between alterations in slow wave/spindle patterns and the clinical as well as cognitive impairments experienced by the individuals. Several EEG studies have revealed deficiencies in spindle attributes, encompassing power, amplitude, duration, and density, among individuals with chronic schizophrenia. The most commonly observed deficiency has been a reduction in spindle density (6). Additionally, the key regions manifesting spindle irregularities in chronic SCZ, as determined through high-density (64-channel) HD-EEG recordings (7,8), are the fronto-parietal and prefrontal areas. Multiple sleep investigations involving drug-free and/or drug-naïve SCZ (9,10) have noted a decline in slow wave activity and density.

MATERIALS AND METHODS: Firstly, we tried to develop a real-time EEG oscillation phase detection algorithm and test its feasibility to be used for closed-loop stimulation. For this we utilised a

closed-loop EEG setup of the lab's ongoing nap research investigation, utilizing the Axonnet X-Amp L10 portable device wirelessly (via bluetooth) connected to python interface (Brainflow Library). EEG acquisition comprised a five-electrode setup (1 ground electrode, 1 reference electrode, and 3 active frontal electrodes: AFz, AF3, and AF4). We used a hilbert-based real-time phase detection method, based on which auditory stimuli (100ms pulses) can be delivered to down phase of slow waves with minimal latency. For real-time automated sleep stage detection for stimulus delivery, we explored functions of YASA toolbox. This algorithm required initial 5 minutes of sleep data for calibration before sleep stage detection.

Next, we tried to study the spindle and slow-wave parameters and understand their difference between control and schizophrenia individuals from a pre-acquired overnight PSG dataset with 19 EEG electrodes. This overnight PSG data of the lab contained multiple night recordings of both control (39) and schizophrenia (45) individuals (Ref: <https://pubmed.ncbi.nlm.nih.gov/29031741/>). After removing artefactual data, 45 subject data (18 SCZ and 27 CNT) could be utilized. YASA toolbox in Python was used to detect slow wave and spindle detection and their properties were noted (frequency, amplitude & duration) in N2 & N3 sleep with respect to control and schizophrenia subjects.

RESULTS & DISCUSSION: We were able to deliver auditory pulses delivered on real-time slow-wave phase detection (Figure 1). But the phase detection was challenged by poor real-time sleep stage detection and failure to correct sleep-movement artefacts. From the dataset study, we found that SCZ exhibit deficits in various sleep spindle parameters (such as sleep spindle density) compared to controls, whereas they display increase in several slow wave parameters (Table 1). For instance, although the slow wave count is higher in the CNT group, the slow wave frequency is greater in the SCZ group, with similar slow wave durations in both groups. We also found a reduction in overall coupling between spindle and slow waves among SCZ when compared to controls (Table 2 & Figure 2). Notably, in SCZ, coupling was highest in frontal sites, while in controls, it is more in the parietal sites. As slow waves were higher in the frontal region in SCZ, it might indicate a compensatory mechanism leading to higher frontal spindle-slow wave coupling. Another finding is that the properties of slow waves coupled with spindles showed difference compared to uncoupled ones, such as longer slow wave duration and higher peak-to-peak value in SCZ.

CONCLUSION: We were able to test the feasibility of closed-loop auditory neuromodulation during nap in a simple setup and identified real-time sleep stage detection as a major challenge. We also identified that spindle and slow wave coupling among SCZ is shifted to frontal sites, and this coupling has influence on slow wave and spindle parameters. Therefore, an optimal closed-loop stimulation

approach for enhancing slow waves in SCZ should focus on improving spindle-slow wave coupling in central and parietal areas among the patients.

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Varied responses to Meditation Training: Impact of Self-improvement motivation

Ramya Neelamegham¹, Vipina Valsan², Vimisha Valsan³, Shyam Diwakar⁴

¹*Amrita School of Business, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala*

²*Department of Electrical and Electronics Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala*

³*School of Spiritual and Cultural Studies, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala* ⁴*Amrita Mind Brain Centre, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala* rneelamegham@gmail.com

Introduction

Indian Knowledge systems (IKS) encompass diverse approaches to attain material (*aparāvidyā*) and spiritual (*parāvidyā*) goals, rooted in *āstika* and *nāstika* *darśanas*, (accepting the authority of Vedas or not). Prominent among *āstika* *darśanas* are Yoga and Vedānta, providing means to elevate consciousness to higher levels with practices like meditation.

While IKS provide numerous meditation techniques, like awareness, mantra meditation, and visualization, to truly benefit, qualities like *shraddha* (faith), *ekagrata* (one-pointedness), and consistent practice are advocated. The Bhagavad Gita (Chapter 6, verse 5) says – *uddharet atmana atmanam* (Each individual should lift himself by his own effort), emphasizing the importance of self-effort and motivation.

By contrast, academic research has primarily focused on one technique mindfulness meditation¹ (Sedlmeir, 2016) and its benefits, with limited research on the motivation to practice meditation² (Jiwani et al., 2022). Studies in universities on meditation typically involve voluntary subjects in small elective classes and report positive effects. However, these results were not replicable in a sizeable mandatory meditation class³ (Neto et al., 2019). Given the mental health crisis of youth, a critical question is who (or which student sub- groups) are most likely to benefit from large meditation interventions? Does self-motivation, suggested in the IKS, influence meditation training benefits, and in what ways?

Objectives

We attempt to answer these questions using data from a mandatory meditation course taught to over 5000 students across India. This course is a contemporary application of IKS. It introduces a meditation technique derived from Yoga and Vedanta, innovatively combining various meditation processes. Our research questions are as follows.

Firstly, among the enrolled students, **who** are more likely to benefit? Following wisdom from IKS, we hypothesize that students with high self-improvement motivation (SIM) are likely to obtain greater meditation training benefits.

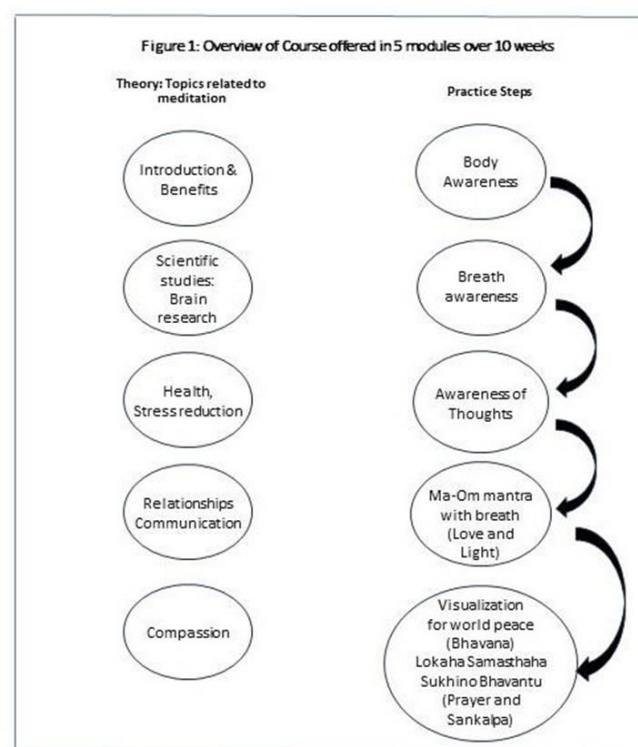
Secondly, we seek to study the **nature of the benefits** accrued from meditation training. Following extant literature¹ (Sedlmeir et al., 2016), we measure impact on four dimensions. We hypothesize that high SIM students are more likely to increase their cognitive flexibility and emotional awareness. They are more likely to withstand stress and be less distracted than students with low SIM.

Lastly, we seek to identify what factors **influence students** to benefit more from meditation training. We test whether family's spiritual background and prior meditation experience influence self-improvement levels.

3. Methodology

We used a pre-test/post-test design to collect data using online questionnaires (at the beginning and end of the meditation course) from a sample of enrolled students. After accounting for dropouts, we obtained a final sample size of 532 students for analysis and hypotheses testing. Ethical approval was obtained (IEC-AIMS-2023-AMBC-40).

The intervention comprised ten bi-weekly 50-minute classes from October to December 2022. Each week, students had one theory and practice session, in which the meditation practice was introduced step-by-step. A new dimension was added to the practice each fortnight, as shown in Figure 1.



In terms of measures, respondents provided data on age, gender, religion, family background in spirituality, prior meditation experience, and SIM during the pre-test. Details of other measures collected at both times are as follows.

Cognitive flexibility, the mental ability to adapt cognitive processing strategies, was assessed using three measures from Di Fabio and Gori (2016)⁴. Measures of self-reported levels of stress and distraction while studying were collected. Emotional awareness was gauged based on respondents' awareness of regret, guilt, and social interactions.

3. Results and Significance of the Work

Descriptive analysis revealed the sample mean age to be 18, with 74% males and 35% having prior meditation experience. The sample was divided into high, medium, and low SIM groups to test the SIM hypotheses, and paired comparison *t*-tests were conducted at the sub- group level.

Table 1 displays changes in pre and post-levels for each sub-group. *Stress levels* increased for the medium and low SIM groups, while no change was observed in the high group. *Cognitive flexibility* improved for high and medium groups in two out of three measures, whereas no change was observed in the low group. The medium and low groups reported increased *distraction*, while the high group exhibited heightened *emotional awareness* of guilt and regret, not found in other groups.

Table 1

Paired-Comparisont-Tests: Self-Improvement Groups						
	High (n = 211)		Medium (n= 228)		Low (n=93)	
	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
How nervous, stressed or tense have you felt in the past three months?	3.19	3.26	2.89*	3.07*	2.92*	3.17*
Cognitive Flexibility						
When faced with change, I can see things from multiple perspectives.	3.68	3.72	3.43+	3.55+	3.06	3.14
I can find the positive in changes that are apparently negative.	3.22+	3.35+	3.11+	3.23+	2.66	2.73

It is easy for me to change my mind, when I realize I am wrong.	3.97	3.92	3.77	3.82	3.39	3.53
Distraction						
While studying, I often get distracted.	3.67	3.71	3.53*	3.68*	3.56*	3.80*
Emotional Awareness						
I feel guilty after criticize others.	3.92*	3.77*	3.72	3.69	3.48	3.63
I worry more about myself than about others.	3.22	3.27	3.02+	3.13+	2.90	2.96
I often try to think about how I can help someone else.	3.82	3.72	3.64	3.61	3.17	3.29
In the heat of the moment, I say something that I regret later.	3.75*	3.51*	3.58	3.47	3.55	3.55

*Significant at 5% level

+Significant at 10% level

Chi-square tests of independence were performed to examine the relationship between SIM, family spiritual background, and prior meditation experience. The results show significant relations for both measures with $X^2(2, N=532) = 23.51, p = .003$ and $X^2(2, N=532) = 8.93, p = .012$ respectively. These results suggest that prior exposure to spirituality and meditation enhances SIM, leading to greater benefits from meditation training.

This research contributes to the theoretical literature on antecedents that make meditation training effective. We find evidence that students with prior background and higher self-improvement motivation experience significant benefits cognitively and emotionally. Secondly, results highlight the need to develop efficacious pedagogy to enhance the motivation of all students to benefit from meditation. Thirdly, the study empirically validates IKS wisdom, emphasizing the need for individual motivation in meditation interventions.

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Exploring Temporal Dynamics in Non-Dual Awareness: A Systematic Review of Neuroscientific and Experiential Perspectives

¹Sandip Bhaise

¹Chinmay Vishwa Vidyapeeth

Abstract:

This research study undertakes a thorough examination that intersects the fields of neuroscience and non-dual awareness. This study examines the relationship between time perception and non-duality, specifically exploring the complex interaction between temporality and non-duality, hence questioning existing temporal frameworks. By integrating subjective experiential descriptions with contemporary neuroscientific investigations, this abstract offers a comprehensive examination of time perception in the framework of non-dual consciousness.

Individuals who have experienced non-dual consciousness often express a significant alteration in their subjective experience. This phenomenon is characterised by an immersive encounter with a state of being that transcends the constraints of time, alternatively referred to as timelessness or, intriguingly, timefulness. Simultaneously, there is an increased preoccupation with the current moment, which disrupts the traditional distinction between the past and future. The malleability of the temporal flow becomes apparent, allowing for the expansion or contraction of moments. The recurring depiction of an everlasting "present moment," liberated from the linear limitations of temporal advancement, is particularly engrossing. Furthermore, skilled individuals who engage in contemplative practises that promote non-dual awareness have reported experiences in which the perception of time seems to be suspended or loses its usual importance. This allows for a deep and focused involvement with the current moment.

Within the realm of neuroscience, this research investigation recognises the progressing nature of our understanding of time perception in the context of non-duality. This recognition justifies the need for thorough empirical investigation in order to reveal the complex neurological mechanisms that underlie this perplexing phenomenon. Despite being in its early stages, this field offers initial observations into the brain processes that regulate distorted perception of time. The multidimensional domain of temporal processing is characterized by the involvement of various neural substrates, such as the prefrontal cortex, insula, parietal cortex, and basal ganglia, which play a vital role in this cognitive process. The integration of sensory inputs, the construction of temporal frameworks, and the shaping of the subjective temporal tapestry are orchestrated by this collective brain symphony.

Exploring the brain mechanisms that underlie the perception of time in highly skilled meditators sheds light on the intricate neurobiological processes associated with non-dual awareness. Utilizing sophisticated techniques such as electroencephalography (EEG), researchers are able to identify observable changes in brain oscillatory patterns that are associated with temporal processing during states of meditation. These modifications suggest a possible adjustment of temporal patterns within the brain, which could potentially influence the unique perception of time experienced during meditation. Significantly, investigations into mindfulness meditation, which shares conceptual similarities with non-dual awareness, emphasize the ability to develop awareness of the present moment in order to improve the accuracy of perceiving time, suggesting a deep connection between the practise of mindfulness and subjective experiences of time.

The complex correlation between non-dual awareness and time perception remains obscured by a layer of complexity, necessitating further exploration of its sophisticated mechanical foundations. It is possible that the disintegration of subject-object dualism, along with the development of present-moment consciousness inherent in non-duality, could result in an alternate way of perceiving and experiencing time. This emerging paradigm has the potential to reduce the dominance of linear temporal progression, thus introducing a comprehensive and potentially everlasting temporal experience. The scope of this study encompasses an examination of the neurological structures involved in emotional processing, specifically the amygdala, insula, and prefrontal cortex. By investigating the intersection of these brain regions, this study aims to provide insights into how the experiential landscape underlying non-duality is regulated.

Furthermore, this study examines the cognitive domain in a systematic manner, focusing specifically on the activation of brain regions related to attention, awareness, and concentration during tasks that do not require significant cognitive effort. The significance of the prefrontal cortex, anterior cingulate cortex, and parietal areas in these cognitive processes highlights their relevance to the cognitive aspects inherent in non-dual consciousness. The inclusion of this cognitive factor enhances the multidimensional narrative of this exploration.

This analysis explores the complex phenomenon of time perception in the context of non-dual awareness, employing a multidisciplinary approach. The synthesis of subjective narratives with neuroscientific findings yields profound insights into the interconnectedness of consciousness, cognition, and brain substrates during experiences of heightened awareness. This comprehensive panorama reveals a deep convergence between these elements.

Computational Analysis of Sleep EEG Data: Decoding Aperiodic Brain Activity in Vipassana Meditators

Nandani Kundal¹, Rahul Venugopal², Arun Sasidharan², Ramajayam G², M Kuttly², Ravindra P. N²

¹Indian Institute of Science Education and Research, Mohali

²Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

Abstract:

Neural power spectra of sleep electrophysiological signals consist of two major components: an aperiodic component represented by a $1/f$ like slope and a periodic component represented by oscillations appearing as bumps above the $1/f$ like slope. Brain activity corresponding to the ' $1/f$ ' slope has been deemed unimportant for a long time and often removed from analyses to emphasise brain oscillations. Emerging evidence suggests that aperiodic brain activity contributes actively to brain functioning. An algorithm which models the power spectrum as a combination of an aperiodic component ($1/f$ slope) and a periodic component (peaks over the $1/f$ slope), called FOOOF (fitting oscillations and one over f) was applied to a set of annotated whole-night sleep EEG recordings of 45 subjects (24 meditating subjects and 21 non-meditating subjects). In this study, extracted aperiodic parameters were analysed for sleep stage sensitivity as well as brain region interaction. The study also investigates whether aperiodic spectral parameters derived from FOOOF analysis of EEG data hold promise as objective measures for characterising sleep states.

Variability of Dream Recall Frequency Across Sleep Stages: Insights from a Serial Awakening Paradigm

Gulshan Kumar¹, Safoora Naaz¹, Arun Sasidharan¹, Ravindra P N¹, Govindaraj Ramajayam¹, Ravi Yadav¹, Bindu Kutty¹

¹Centre for Consciousness Studies, National Institute of Mental Health and Neuro Sciences,
Benagluru

Abstract:

Introduction: As we delve into investigating dream recall frequency, a significant challenge arises from the occurrence of dreaming in both REM (Rapid Eye Movement) and NREM (Non-Rapid Eye Movement) sleep. This phenomenon of dreaming is not limited to a specific sleep stage but can take place in both REM and NREM sleep states. Therefore, understanding and measuring dream recall rates and dream experiences necessitates considering and analyzing dreams from both of these sleep stages.

Methods: In the present study, we recruited 23 subjects, both male and female, between the ages of 20–35 years. On the first night, all participants slept undisturbed with the 64 electrodes in place. During the second night, subjects were randomly awakened via serial awakening paradigm and asked for dream reports. In our research, we administered an average of 8 alarm-based awakenings to elicit dream reports randomly during both NREM and REM stages. By employing polysomnography (PSG)-based awakenings, we established a controlled experimental setting to systematically investigate dream experiences in NREM and REM stage.

Results: The present study yielded intriguing findings regarding dream experiences and their recall during different sleep stages. In NREM Stage 2 (N2) sleep, 21.4% of participants reported having dream experiences, but they couldn't recall these dreams upon awakening. However, in the same N2 stage, 59.6% of participants had both dream experiences and successfully recalled them upon awakening. On the other hand, during N2 sleep, 19.1% of participants did not have any dream experiences. Moving to REM sleep, during this stage, 10.7% of participants had dream experiences, but they could not recall the content of these dreams upon awakening. However, a considerable majority, 78.7%, experienced dreams during REM sleep and were able to recall them afterward. Interestingly, in REM sleep, 10.7% of participants did not report any dream experiences.

Discussion: The findings of this study highlight the intricate nature of dream phenomena during sleep, wherein dream experiences manifest in both NREM and REM sleep stages, while the capacity to recall dreams exhibits variations across these distinct sleep phases. The observed heterogeneity in dream recall rates underscores the need for additional research to unravel the underlying neural mechanisms governing dream generation and the factors that modulate dream recall frequencies. Further investigations are warranted to elucidate the neurobiological substrates involved in the formation of dreams and the complex interplay of cognitive processes influencing the retrieval of dream content from memory during different stages of sleep.

Examining EEG Microstate of Indian Raga

Ashish Gupta¹, Chandan Srivastava², Laxmidhar Behera³, Braj Bhushan⁴

¹ Department of Electrical Engineering, Indian Institute of Technology, Kanpur

² Department of Humanities and Social Sciences, Indian Institute of Technology, Bombay,

³ School of Computing and Electrical Engineering, Indian Institute of Technology, Mandi, India

⁴ Department of Humanities and Social Sciences, Indian Institute of Technology, Kanpur, India

Abstract:

Music's multifaceted influence on cognitive and emotional processes has been a subject of profound interest, especially because of music's unique ability to transcend musical domains and impact non-musical domains, including intelligence, attention, and emotion. However, the specific electroencephalogram (EEG) microstates that underlie these cognitive impacts are not fully comprehended. This study sought to delve into the brain's microstates linked to happiness and sadness, particularly in the alpha frequency range, using Indian Raga compositions.

Through an analysis of Global Explained Variance (GEV) and Global Field Potential (GFP), the investigation revealed that exposure to happy Raga music triggered an increase in class D microstate activity and a decrease in class C microstate activity in comparison to the before music resting state. On the other hand, engaging with sad Raga music corresponded to an elevated presence of both class C and class D microstates, as indicated by the GEV and GFP analysis. Class C microstate is associated with wandering thoughts specifically self-referential processing, while class D microstate is connected to attention. The results propose that the heightened attention often experienced during happy music listening could be attributed to the rise in class D microstate activity and the reduction in class C microstate activity. Similarly, the simultaneous increase in both class C and class D microstates may contribute to the improved regulation of emotions and self-regulation commonly observed during sad music listening.

Contents of thought during rest is shaped by personality types: A pilot study

Amritharekha Nayak¹, Arun Sasidharan¹, Ramajayam G¹, Jamuna Rajeswaran², Bindu M. Kutty¹,
Ravindra P.N¹

¹Centre for Consciousness Studies, Dept. of Neurophysiology, NIMHANS

²Dept. of Clinical psychology, NIMHANS

Abstract:

Mind wandering is a broad term, can be defined as thoughts occurring spontaneously and are not tied to immediate environment. Mind wandering can occur during the resting time and its contents can be analyzed by subjective reports of the subjects. One such scale to analyze the contents of thought is ARSQ (Amsterdam Resting-State Questionnaire) that analyses the thought contents as per 10 domains: Discontinuity of mind, Theory of mind, Self, Planning, Sleepiness, Comfort, Somatic awareness, Health concern, Visual thought and Verbal thought. This study aims to assess any relation between these domains of thought contents that are generated during rest and further if they show any relation with various personality types classified as per both conventional and traditional methods

Prajñā: Intuition or Beyond?

Swati Semwal¹ Dr. Rekha Singhal²

¹Research Assistant, Centre for Indian Knowledge Systems, Chanakya University, Bengaluru

² Professor and Dean, Faculty of Contemplative and Behavioural Sciences, Sri Sri University, Odisha

Abstract:

The field of psychology has been rigorously working on understanding the source and origin of human cognition over the years. All the possible mental phenomena like perception, attention, memory, intelligence, etc. fundamental to human functioning have been topics of great curiosity in this discipline. However, 'Intuition' despite being an extremely common phenomenon in everyone's daily experience has almost been neglected and missed by psychologists, on the grounds of being non-empirical, non-scientific, and hence, a non-issue. A broader phenomenon 'Prajna', in the Indian tradition, that has mostly been translated to intuition in English has been considered higher than and beyond any other forms of cognition, so much so, that it is considered the only reliable phenomenon capable of acquiring perfect and errorless knowledge and being validated across time and space. Not just this, but this phenomenon is also linked to the refinement of all the cognitive processes and is hence, capable of bringing a revolution in the field of psychology by offering answers to some of the most fundamental concerns of the discipline and helping us realize the true potential of a human being. This study is an attempt to give a brief overview of the magnificence and immense potential of this phenomenon in enriching all the domains of psychology, and also an attempt to shed some light on the necessity of taking Indian classical texts into account for a more integrated and universal psychology. As a part of this research, intuition has been approached from three vantage points i.e., mainstream psychology, classical Indian texts, and first-person experience. The results show that all three perspectives believe that intuition can be developed, is something beyond logic and reasoning, and leads to creativity. Apart from that, the Indian classical texts offer a much deeper understanding of the term with ways of developing it, results of which have also been proved again by the first-term experience of long-term yoga practitioners. The Indian concept of Prajna also talks about an overall positive transformation in the individual in the process of development of Prajna, which is an urgent need in current times. Therefore, the results indicate an immediate need for paying attention to the existing gap in our understanding of cognitive phenomena and its expansion by adopting a paradigm that encompasses 'Prajna' as a key aspect of the spectrum of the discourse on wisdom.

Yogic Visual Concentration (Trataka): Yogic Wisdom and its pertinence in ocular and mental health

Sushma Ns¹

¹Associate professor Department of Shalakya tantra, Research officer, Amrita School of Ayurveda

Abstract:

Background and Rationale: Yogic Visual Concentration (Trataka) methods, derived from India's rich cultural and scientific heritage, include Trāṭaka, a technique used in Ayurvedic treatment for eye disorders. The eyes play a crucial role in mental well-being, receiving about 80% of sensory information(Diao Y 2017); Ayurveda practitioners incorporate Trataka in eye exercises, benefiting eye health (Ashtanga) to restore the physiological functions of Vata, Pitta, and Kapha, thus benefiting the eyes. Studies show that visual mental imagery and eye gaze impact brain regions; responsible for arousal, cognitive functioning (Eckstein MK 2017) and visual cortex excitability (Sparing 2002). This paper aims to explore Trataka's potential in treating eye pathologies and mental health, bridging Ayurveda and modern medicine. The study aligns with SDG 3, promoting affordable and improved healthcare. It is hypothesised that Trataka may help to connect the soul, mind, sensory organ, and perception object, improving visual perception(Charaka). The study will help grow Ayurveda and modern medical science due to the procedure's implications in addressing the positive neuro impacts and the ophthalmological conditions and exploring how Trataka addresses eye diseases and mental health.

Methods:

This review study includes all scientific papers related to Trataka/Yogic Visual Concentration, Ayurveda and other papers explaining the utility of gazing, visual perception and visual imagery available in the PubMed, Scopus and ResearchGate databases. We then classified the data from these papers and analysed them under separate subject headings of “attention and cognition”, “autonomic functions”, “eye disorders”, “effect on other disorders”, “eye gazing and focusing” and review papers on Trataka.

Results:

Using appropriate keywords and filters, we identified 131 papers and narrowed it down to 22 upon eliminating the duplicates and irrelevant papers. We obtained a list of the diagnostic methods and tools used in the selected relevant papers. For “Attention and Cognition”, CFF, Stroop-colour-word test, Digit

span, SLCT test, Trail making, Test B (TMT-B), Hamilton anxiety scale, Mobile-based flame gazing, letter cancellation test, the effect of autonomic functions, HRV and breathing rates were used. For studies related to “Eye Disorders”, the VF scale, VS checklist, MW questionnaire, SMAAS, IOP, SBP, RR, DBP, FBG, and pulse rate in T2DM, BCI, Snellen’s chart, ISI and PCQL, Corsi-Block tapping task, BP & HR and other subjective and objective parameters were used to understand the effect of the procedure.

Discussion and Conclusion:

From the results obtained, we understood that various diagnostics and tools are used in understanding the effect of Trataka, and they have all contributed significantly. But specific gaps are also to be filled to ascertain deeper insight into the procedure. We want to present the results of our review in detail and the conclusions drawn from them in our presentation. The scope of this study is that it brings together the evidence of the practice of Trataka, a piece of valuable knowledge from the Indian Knowledge System. Also, it addresses the SDG 3 of good health, which is affordable and improves the overall quality of living. The neural underpinnings of the technique’s implication in terms of relaxation degree analysis and cortical correlations of the underlying resting state networks remain yet to be explored. Hence working in this direction, we also want to propose a blueprint of the scope of future studies, like using EEG electrodes to understand the effects of activity signatures in cortical areas attributed to the effects and impact of Trataka as an Ayurvedic neuro-ophthalmic intervention on human subjects.

Harnessing India's Ancient Wisdom: Exploring the Synergy between the Indian Knowledge System and Atmanirbhar Bharat

Ayush¹, Amit Gangotia¹

¹Central University of Jammu

1993ayush@gmail.com

Abstract:

Purpose- India, the land of diverse culture and rich heritage also has a pool of ancient wisdom that extends to fields of philosophy, sciences, mathematics, medicine and governance. This ancient knowledge system, rooted in the Vedas, Upanishads, Ayurveda, and other ancient texts, holds immense potential to drive the progress of a self-reliant India, also known as Atmanirbhar Bharat. This paper aims to explore the synergy between the Indian knowledge system and the goals of Atmanirbhar Bharat from the lens of tourism, highlighting the significance of harnessing our ancient wisdom in shaping a prosperous and sustainable future. **Approach -**The study is qualitative in nature which involves a comprehensive analysis of existing literature, case studies related to the Indian knowledge system and Atmanirbhar Bharat. It also includes an examination of successful initiatives that are instrumental in harnessing traditional knowledge systems for sustainable development within India. **Findings-** The study will contribute toward the existing literature related to Indian knowledge system and will put forth the important social and economic implications in tourism industry. Highlighting the potential benefits of integrating India's ancient wisdom into the vision of Atmanirbhar Bharat, as well as how we can en-cash it with tourism that may provide new and vivid verticals to the Indian tourism industry. By reviving the Indian knowledge system we can forge a unique path towards prosperity, resilience and global leadership.

Originality/value- The study will contribute toward the existing literature related to Indian knowledge system and will put forth the important social and economic implications in tourism industry. Highlighting the potential benefits of integrating India's ancient wisdom into the vision of Atmanirbhar Bharat, as well as how we can en-cash it with tourism that may provide new and vivid verticals to the Indian tourism industry. By reviving the Indian knowledge system we can forge a unique path towards prosperity, resilience and global leadership.

Keywords: Grassroot Level Innovator, Community based tourism initiatives, Self-employment etc.

1. Introduction

Atmanirbhar Bharat, which translates to "self-reliant India", is an initiative launched by the Government of India with the aim of making India economically independent and self-sustaining across various sectors (Jain, Gill, et al., 2022), it encompasses several aspects, including the promotion of indigenous industries, reducing dependency on imports, fostering innovation and entrepreneurship, and leveraging India's rich cultural heritage and knowledge systems (Dubey & Dubey, 2020; Kapoor & Tyagi, 2021; Massand, Ambreen, & Lodi, 2020). The Indian knowledge system, rooted in ancient wisdom and traditional practices, encompasses diverse fields such as Ayurveda, yoga, traditional medicine, agriculture, architecture, art, music, and more, these systems have been developed and passed down through generations, representing India's intellectual and cultural heritage (Azmi & Ismail, 2016; Basavaraddi, 2015; Connell, 2006; Shankar, 2015). India's cultural and natural diversity, combined with the knowledge systems, offers unique opportunities for tourists to engage with traditional practices, holistic healing, and immersive cultural experiences. After COVID 19 the tourism sector has taken a hit, the ancient practices of Ayurveda, yoga, meditation, and holistic healing to attract wellness tourists seeking rejuvenation and relaxation (Ayush, Gangotia, & Pradhan, 2022). This paper seeks to harness the potential of the Indian knowledge system in the tourism sector while making India Atmanirbhar. The immersive tourism experiences based on Indian knowledge systems can promote cultural tourism by promoting heritage sites, indigenous festivals, local art forms, traditional cuisine. Ayurvedic retreats, yoga centres, and wellness centres operated by local community (Community based Tourism) can be developed, providing visitors with authentic and transformative experiences. Community based Immersive tourism also give opportunities of Skill development and capacity building within local communities by promoting traditional crafts, music, dance, and other 2 art forms. This not only preserves cultural heritage but also creates employment opportunities, particularly in rural areas while incorporating eco-friendly and sustainable practices. To evaluate this research model Structural equation modeling technique is employed.

2. Background of the study

2.1 Atmanirbhar Bharat

Atmanirbhar Bharat Abhiyaan, a vision of New India to make India "self-reliant". It is a blend of Gandhian Philosophy of "Swavalamban" & Modi's "Make in India" Campaign, and is focused on attracting FDI, investment & innovation in India (Dubey & Dubey, 2020; Haran, Kurian, & Ohja, 2021). The vision of Atmanirbhar Bharat is to build a strong and resilient Indian economy by encouraging domestic production, promoting entrepreneurship, and fostering innovation across various sectors (Alam, Khan, Ghosal, & Satpati, 2021), It focuses on five key pillars: economy, infrastructure, system,

demography, and demand (De & Roy, 2021). The Atmanirbhar Bharat initiative encompasses several key sectors, including agriculture, manufacturing, infrastructure, defence, and technology, it aims to create a favourable ecosystem for domestic industries, facilitate ease of doing business, and encourage the development of indigenous capabilities (M. Singh, Singh, Tiwari, Saxena, & Shukla, 2023). The focus is on fostering innovation, research and development, skill development, and technology adoption to drive sustainable growth and job creation (R. Singh, 2023). The initiative also highlights the importance of leveraging India's rich traditional knowledge systems and indigenous resources, it seeks to harness the potential of traditional sectors such as Ayurveda, Yoga, and other indigenous sciences, promoting them both domestically and globally (Lele & Patwardhan, 2020). By combining traditional wisdom with modern advancements, Atmanirbhar Bharat envisions a self-reliant India that is not only economically strong but also rooted in its cultural heritage (Amrutrao, 2023). To support the Atmanirbhar Bharat vision, the government has implemented various policy reforms, incentives, and programs, which include promoting domestic manufacturing through initiatives like Make in India (Bansal & Goyal, 2016), encouraging digital transformation through initiatives like Digital India (Goswami, 2016), and facilitating ease of doing business through regulatory and administrative reforms (Amrutrao, 2023). Atmanirbhar Bharat is a comprehensive and evolving concept that aims to transform India into a globally competitive nation with a robust and self-sufficient economy, it strives to foster sustainable development, create employment opportunities, and improve the standard of living for all citizens, while also reinforcing India's position on the global stage (Amrutrao, 2023).

2.2 Indian Knowledge System and Tourism

The basic component of any country's knowledge system is its Indigenous Knowledge (IK). Rao (2006) provides an overview of IK by describing it as local and tacit knowledge that is unique to a certain culture or community and serves as the foundation for local-level decision-making; its features, kinds, and influence on social development. The purpose of Dandekar et al. (2021) is to present information about ancient Indian knowledge systems and how traditional items such as cow products may be beneficial in manufacturing enterprises in order to inspire entrepreneurship in rural India. India is the birthplace of yoga, and its ancient texts, including the Yoga Sutras of Patanjali, form the basis of modern yoga practices (Basavaraddi, 2015; De Michelis, 2005). Ayurveda is an ancient Indian system of medicine, the integration of Ayurveda into wellness resorts and healthcare facilities has boosted medical tourism in India (Connell, 2006; Dawn & Pal, 2011; Ebrahim & Ganguli, 2019). India's rich cultural heritage, including classical dance forms, music, and art, attracts tourists interested in experiencing traditional Indian culture (Azmi & Ismail, 2016; Timothy, 2011). India is home to numerous historical sites, including the iconic Taj Mahal and ancient temples, the study of ancient Indian texts and inscriptions plays a vital role in preserving and understanding these historical sites (Shankar, 2015; Timothy, 2011; Worthing & Bond, 2008). Indian cuisine is diverse and deeply rooted in traditional knowledge systems, tourists often explore local cuisine, spices, and cooking

techniques (Baruah, 2016; Updhyay & Sharma, 2014). India has a wide range of flora and fauna the tourists visit national parks and wildlife sanctuaries in India for ecotourism (Hameed & Khalid, 2018). The Indian knowledge system is rich and diverse, encompassing a wide range of fields, from ancient philosophical and scientific texts to traditional arts and crafts. Tourism in India is closely linked to this knowledge system, as visitors from around the world come to explore the country's historical, cultural, and natural attractions. The Indian Knowledge system based tourism can be themed in following categories.

2.2.1 Farm Tourism

Farm-based businesses are often encouraged to integrate their farm-based resources and talents with those from other areas, which can legitimise more sustainable practises and enhance profitability (Hersleth, Kubberød, & Gonera, 2022; Sanye-´ Mengual, Specht, Grapsa, Orsini, & Gianquinto, 2019). Integrating farming and tourism is one such sector, small farmers are exploring the possibilities of alternative economic methods, such as incorporating tourism (Ammirato, Felicetti, Raso, Pansera, & Violi, 2020). Zurinani, Rodiyah, Prastyo, and Arifky (2019) aims to formulate a strategy for developing edu farm tourism in Brau hamlet, the strategy of developing edu farm tourism in Brau Hamlet is done aggressively using the concentration of vertical integration, that is carried out at various stages of the supply chain of cattle farm, such as; Dairy Nursery, taking care of cattle, processing cow's milk into finished products, waste management and product marketing. Gugerell, Penker, and Kieninger (2019) examined and draw comparisons between 'cow sharing' setups throughout the European Alpine Region. These arrangements represent a type of rural, digitally facilitated sharing approach that promotes the direct sale of premium goods and the cultivation of social connections with both visitors and customers. Smythe, Bidwell, Moore, Smith, and McCann (2020) carried out an investigative qualitative research project that involved organizing focus group discussions with tourism and recreation experts and enthusiasts. These conversations delved into their insights and encounters with the project, uncovering the wind farm's distinctive potential as a recreational fishing spot. The study conducted by Nematpour and Khodadadi (2021) sought to pinpoint the primary economic advantages that farm tourism brings to rural communities in Iran, the research utilized stepwise regression analysis to determine the essential farm tourism factors that contribute to socioeconomic growth. These factors encompass enhancements in learning and educational activities, cultural development, increased community engagement, a flourishing local economy, the pursuit of personal values, income generation, improvement in the quality of life, and business development. Ayush et al. (2022) highlights the significance of cow tourism and social entrepreneurship. This research not only praises the concept of social entrepreneurship centered around experiential tourism related to cow rearing in Himachal

Pradesh but also emphasizes the role of native Indian cattle in society. Agritourism can be defined as “any farm-based business offered for the enjoyment and education of the public, to promote the products of the farm, and thereby generate additional farm income” (Karabati, Dogan, Pinar, & Celik, 2009, p.129). Agritourism is gaining popularity in USA, China and India however bulk 5 of agritourism research comes from the United States, the United Kingdom, and the Netherlands, while researches in agricultural nations such as Asia and Africa is scarce (Rauniyar, Awasthi, Kapoor, & Mishra, 2021).

2.2.2 Wellness Tourism

Smith and Puczko (2008) defined wellness tourism as travel for the purpose of ‘maintaining or enhancing one’s well-being through physical, psychological, or spiritual activities. According to Mueller and Kaufmann (2001) who conducted a market analysis of a special health tourism segment and its implications for the hotel industry, average three- to five-star hotels provide fairly comprehensive wellness facilities, and ‘Yoga tourism’ has emerged and grown alongside the ‘travel to feel well’ trend. Lehto, Brown, Chen, and Morrison (2006) investigate this under-researched sector by conducting interviews and surveys with yoga retreat attendees in central Indiana, USA, the findings are useful for tour operators and venues looking to establish niche travel markets by tapping into the increasing special-interest tourism sector. New psychotherapies, complementary treatments, and now an expanding wellness leisure and tourist industry. Chen, Prebensen, and Huan (2008) present a novel research issue about travel motivation to wellness places, due to the scarcity of definitions for such a phenomena, this study first defines it before launching an empirical investigation to investigate the underlying motivating elements, the top four incentives are rest, numerous activities, recreation, and appreciating nature while relaxation being most important. In the study conducted by Voigt, Brown, and Howat (2011), component analysis was utilized to uncover six distinct categories of benefits sought by three distinct groups of wellness tourists, namely those visiting beauty spas, lifestyle resorts, and spiritual retreats. These benefit factors included elements such as transcendence, physical well-being and aesthetics, seeking escape and relaxation, valuing important relationships and novelty experiences, rebuilding self-esteem, and indulgence. According to L. Huang and Xu (2018) the healing process of visitors is influenced by three key elements: the natural environment, social interaction, and the symbolic landscape. Among these factors, the symbolic landscape, significantly shaped by culture, assumes a prominent role in the overall healing process. The contribution of Patterson and Balderas-Cejudo (2023) offers an extensive examination of how tourism positively affects the well-being and overall health of older adults. Additionally, it presents a conceptual analysis that fills the research void between tourism and demography, particularly in relation to travel by older individuals, emphasizing the role of such travel in promoting a healthy lifestyle 6 and enhancing well-being. Li and Wen (2022)

put forward practical recommendations to rejuvenate the growth of health tourism centred around forests during the COVID-19 pandemic. Furthermore, their work also illuminates the significance of social trust in encouraging urban residents to make behavioural choices related to wellness tourism in forest settings. In the study by Liao, Zuo, Xu, Law, and Zhang (2023) a comprehensive analysis was conducted on the health advantages discussed in numerous interdisciplinary research papers dating from 2002 to the current year. Medical tourism covers medical and health resort-related activities, while health-enhancing tourism encompasses balneology, spa tourism, and wellness tourism. Agalarova, Rozanova, Stytsiuk, and Tavakov (2023) investigated the issues of medical health-improving tourism development in present conditions, The supply and demand for health-improving tourism in 2014-2020 is examined. Existing research on visitors' behavioural intentions impacted by their motivation in health and wellness tourism is sparse, Gan, Zheng, Li, Li, and Shen (2023) investigated the aforementioned effects with a sample of 493 visitors who had travelled in health and wellness tourism, which revealed that health and wellness tourism industries are encouraged to meet the intrinsic motivation of travellers and make them perceive the value of this type of tourism, which in turn promotes tourists' choice, evaluation, and satisfaction of health and wellness tourism.

2.2.3 Traditional lifestyle or Cultural Tourism

Richards (2018) described Cultural tourism "as a type of tourism activity in which the visitor's essential motivation is to learn, discover, experience and consume the tangible and intangible cultural attractions/products in a tourism destination" (Richards, 2018, p.3), further they explored the motivations of cultural tourists, such as the desire for authentic experiences, education, and personal enrichment. Noonan and Rizzo (2017) delves into the economic aspects of cultural tourism, including its potential for generating income, employment, and revenue for local communities. Gjerald (2005) examined the potential socio-cultural impacts of cultural tourism, including issues related to cultural authenticity and conflicts. Richards (2018) explores the role of creativity and cultural events in destination marketing for cultural tourism. Jamal and Getz (1995) explores the importance of collaboration and community involvement in the planning and development of cultural tourism initiatives. ?discusses the challenges and opportunities associated with cultural heritage preservation and its integration into tourism in developing regions. Tourism and culture have long been intricately interwoven. Cultural 7 sites, attractions, and events are essential motivators for travel, and travel creates culture.

2.2.4 Sports Tourism

Kurtzman (2001) give a viewpoint directly related to the economic impact of sports tourism. However, the coverage focuses mostly on 'cycling vacations' of one kind or another, with day trips and bike

racing being overlooked. The study by Bull (2006) attempts to rectify the existing imbalance by investigating the travel behavior, attitudes towards place and environment, as well as the socio-economic and demographic characteristics of a small group of racing cyclists in East Kent, who can be classified as avid sports tourists due to their high activity importance and participation levels. In addition to this, the study offers a comprehensive overview of the existing research in the field of sports tourism by analyzing the paths taken by previous reviewers. The research findings highlight that bikers constitute a significant segment within the sports tourism community, not only in terms of their travel patterns but also in their associated behaviors and motivations. To bridge this research gap, the study introduces a conceptual framework that provides a solid theoretical foundation for understanding the organizational structure of regional sports tourism organizations. The objective of the study conducted by Lee and Kim (2023) was to identify the reasons why wellness tourists choose to visit, and then create market segmentation strategies for the wellness tourism industry based on these visit motivations. X. Huang (2023) shows that the research on sports events in China has received high attention from scholars, and its research content mainly includes- legal protection of issues such as sports event broadcasting, the role of sports events in the development of sports industry, the operation and management of large sports events, sports events and sports tourism development, the role of sports events on urban development, etc. In line with the findings of Widianingsih et al. (2023), to attain lasting progress in regional development and urban resilience through sport tourism event planning, it is essential to shift the emphasis away from purely economic goals and also consider factors like socio-cultural and environmental dimensions. Cheng, Zhang, and Li (2023) have constructed an assessment framework by utilizing panel data gathered from nine provinces and regions situated in the Yellow River Basin during the years 2011 to 2020. Subsequently, they calculated a development index and conducted an analysis of the influencing factors. The methods employed for this analysis included the entropy method, the coupling coordination degree model, kernel density estimation, and grey correlation analysis. The study's results indicate that the overall development in the sports and tourism sectors in the Yellow River Basin has seen an increase. Furthermore, the geographical growth pattern suggests that the Lower Yellow River region outpaced the Upper Yellow River and Middle Yellow River regions. In addition, the coupling coordination state transitioned from a state of mild disorder to one of good coordination.

3. Research Methodology

This research attempts to give a notion of economic activity in rural areas by integrating Indian Knowledge system and experiencing tourism in order to achieve Atmanirbharta, a self-sustaining ecosystem focused on “Vocal for Local”. To explore the benefits of Indian knowledge system based tourism multiple case study method was applied, in which successful models of IKS based enterprises were selected across India which are making local community self-reliant. The study is qualitative in

nature and employs narrative analysis of secondary data to emphasise the significance of IKS and immersion tourism. The multiple case study analysis approach was employed to assess the online available interviews from YouTube, Facebook and other platforms, in order to access the production, usage of technology, resource utilisation, and community participation. The interviews were then transcribed and analysed using NVivo software, leading to the discovery of several nodes.

4. Findings & Discussions

Enterprise - Jor Ki Dhani

Kan Singh Nirvana, a farmer from Sikar, Rajasthan, has embarked on an innovative journey that combines agriculture, eco-tourism, and sustainability. His story is a remarkable case study that showcases his dedication to promoting organic farming, preserving traditional agricultural practices, and transforming his land into a thriving eco-village.

Innovation and Entrepreneurship:

In 2005, Kan Singh introduced a unique concept by creating Jor Ki Dhani, an eco-village where tourists can experience rural life and enjoy nature. He used locally sourced materials like cow dung and soil to construct 20 luxury rooms, which attract domestic and foreign tourists. ⁹ His innovative approach led to the successful integration of farming and tourism, resulting in an annual profit of up to Rs 1.5 crore. Kan Singh's farm spans 100 bighas, where he practices organic farming of crops like sorghum, millet, and spices. In addition to traditional crops, he grows medicinal and Ayurvedic plants, providing a diversified source of income. Kan Singh's farm is also home to Gir breed cows and horses. This combination of livestock and crops exemplifies his commitment to traditional farming practices. He emphasizes the significance of animal husbandry alongside farming for comprehensive agricultural success.

Traditional Practices:

Kan Singh places great importance on adhering to traditional farming methods, such as the use of cow dung as fertilizer and avoiding machines in the processing of spices. He believes these practices lead to healthier crops and have benefits for both the environment and human health. The rooms and huts at Jor Ki Dhani are constructed from eco-friendly materials, making them warm in winter and cool in summer. The use of cow dung and thatch for roofing exemplifies his dedication to creating a sustainable environment. Kan Singh highlights the environmental and health benefits of using cow dung manure, emphasizing that it enriches the soil with microorganisms and reduces the need for chemical fertilizers.

Community engagement and Empowerment:

Kan Singh promotes the concept of a "family farmer" by involving 300 families from across the country in his organic farming network. Kan Singh's wife, Sushila, actively participates in managing the farm, which is an example of women's empowerment in agriculture. These families visit his farm to purchase organic food, vegetables, and spices, eliminating the need for market intermediaries. Kan Singh's farm serves as an educational center for students, including IIT and diploma students. Visitors can learn about organic farming, Ayurvedic plants, and sustainable agricultural practices. The region around Jor Ki Dhani is rich in cultural and religious attractions, which adds to the potential for rural tourism. Kan Singh emphasizes that rural tourism can lead to economic development, employment opportunities, and cultural exchange in the region.

Enterprise - Geeli Mitti Farms:

Geeli Mitti Farms is a remarkable example of a social enterprise founded by Shagun Singh with the mission of promoting sustainable living through natural building, permaculture, and sustainable tourism. This case study analysis will delve into the key aspects of Geeli Mitti Farms, including its history, current activities, benefits to individuals, communities, and the environment, constraints it faces, and the overall positive impact it has on sustainable living and social entrepreneurship.

Innovation and Entrepreneurship:

Geeli Mitti Farms was initiated in 2014 by Shagun Singh, who left her corporate job to follow her passion for sustainable living and the potential of natural materials like mud in building. The farm was started with a small piece of land in Uttarakhand, and it has grown into a thriving community over the years. Shagun began by building a cob house for herself and later started offering workshops on natural building to others. The farm's vision is to create a sustainable community that lives in harmony with nature and educates people about sustainable living. Geeli Mitti Farms offers a wide range of programs and activities, including natural building workshops, permaculture workshops, yoga and meditation classes, nature walks, birdwatching tours, and cultural events. It has become a popular tourist destination, attracting visitors from around the world who come to stay at the farm and learn about sustainable living. The farm is known for its various types of natural homes, such as cob houses, earthbag houses, and straw bale houses. It also provides accommodations like guest houses, camping, and tree houses. Geeli Mitti Farms is involved in social and environmental initiatives, including providing employment and training to local communities and working on environmental conservation.

Community Engagement and Empowerment

Geeli Mitti Farms offers opportunities to learn about sustainable building, permaculture, and sustainable living. The farm provides employment and training to local communities, contributing to their livelihoods. It also actively works to conserve the local environment and promotes sustainable tourism.

Geeli Mitti Farms supports the development of sustainable communities. The farm's natural building and permaculture workshops promote the use of sustainable materials, reduce the environmental impact of construction, and improve food security through sustainable agriculture practices. Yoga and meditation classes foster a deeper connection with nature. Nature walks and birdwatching tours encourage an appreciation for the local environment. Cultural events help preserve and promote local culture and traditions.

Constraints and Positive Impacts:

As a non-profit organization, the farm relies on donations and grants, which can limit its ability to expand and develop new programs. The farm has a small staff and relies on volunteers, making it challenging to scale up operations. Being located in a remote area limits its reach to the target audience. Geeli Mitti Farms has trained hundreds of people in sustainable practices and created sustainable livelihoods for local communities. The farm has been recognized for its work in conservation and sustainable tourism. It serves as a model for social enterprises promoting sustainable living and social change.

Enterprise-Gau Kasht

Dr. Yogendra Saxena is a renowned Indian environmentalist and the founder of Gau Kasht Man "Home of the Cow". He is known for his work in promoting sustainable agriculture, animal welfare, and environmental conservation. He founded Gau Kasht in 1993 as a sanctuary for cows, which provides cows with a safe and comfortable place to live, and it also promotes the use of cow-based products such as milk, yogurt, and manure.

Benefits: Cow dung wood is a sustainable and renewable resource. It is produced using a simple process that does not require any harmful chemicals or energy-intensive processes. Cow dung wood is biodegradable and does not pollute the environment. It helps to reduce methane emissions from cow dung, which is a greenhouse gas. Cow dung wood is naturally antibacterial and antifungal. It helps to purify the air and improve indoor air quality. It is also believed to have therapeutic properties and can help to relieve stress and anxiety. Cow dung wood is a good insulator and can help to reduce energy consumption for heating and cooling buildings. Cow dung wood helps to purify the air by absorbing harmful pollutants. Living in a house made of cow dung wood can help to reduce the risk of respiratory problems such as asthma and allergies.

Constraints Gau Kasht Woods is a remote and inaccessible area, with limited access to roads, electricity, and other infrastructure. This can make it difficult to conduct research and conservation work in the area. The terrain in Gau Kasht Woods is challenging, and it can be difficult to transport equipment and supplies into the area, which makes it difficult to conduct research and conservation work efficiently. There is a significant level of human-wildlife conflict in Gau Kasht Woods, as people

and animals compete for resources such as land and water. This 12 can make it difficult to protect wildlife and their habitats

4.1 Entrepreneurs leading community towards Atmanirbharta (Self-Reliance)

As the literature suggests, for Atmanirbharta (Self Reliance) we need to strengthen the core 5 Pillars which are Economy, Infrastructure, Community, Technology and Demand and Supply.



Figure 1: 5 Pillars of Atmanirbharta Source – The figure is created by the Authors based on the interviews and Literature Review.

With the above case studies we can conclude that the Enterprises are indeed empowering and strengthening these pillars, detailed analysis is as under.

4.1.1 Economic Empowerment

Kan Singh's eco-village combines farming and tourism, providing multiple sources of income. This diversification enhances the economic stability of his community. Geeli Mitti Farms provides employment and training to local communities, contributing to their economic empowerment and livelihoods. By promoting sustainable practices, the farm enhances the income-generating potential of the region. Whereas Gau Kasht promotes the use of cow-based products such as milk, yogurt, and manure. This encourages economic opportunities for individuals involved in the dairy and agricultural sectors.

4.1.2 Infrastructure Development

The use of locally sourced and eco-friendly materials for building rooms and huts in Jor ki Dhani demonstrates a commitment to sustainable infrastructure, the creation of 20 luxury rooms attracts tourists, improving the overall infrastructure of the region. The Geeli Mitti Farms specializes in natural building techniques, constructing various types of natural homes. This focus on eco-friendly construction contributes to sustainable infrastructure development as the farm offers a variety of accommodations, including guest houses, camping, and tree houses, which not only benefit tourists but also enhance the local infrastructure for sustainable tourism. Whereas the Gau Kasht promotes the use

of cow dung wood for construction that supports sustainable infrastructure development. It provides a natural and renewable resource for building materials.

4.1.3 Community Empowerment

Kan Singh's initiative (Jor Ki Dhani) involves 300 families from across the country in his organic farming network, this not only provides them with economic opportunities but also strengthens the community. The active participation of Kan Singh's wife, Sushila, in managing the farm is an example of women's empowerment in agriculture. Kan Singh's farm serves as an educational centre for students, contributing to community development by imparting knowledge and skills. Geeli Mitti Farms offers workshops and programs to educate individuals about sustainable living, natural building, and permaculture; this empowers people with valuable knowledge and skills, the farm actively engages in environmental conservation efforts, fostering a sense of community responsibility and engagement in protecting the local environment. Cultural events organized by the farm help preserve and promote local culture and traditions, further strengthening community ties. Gau Kasht serves as a sanctuary for cows, ensuring their well-being and providing a safe and comfortable place to live. This contributes to animal welfare and fosters a sense of community responsibility toward the care of these animals, the promotion of cow-based products benefits local communities by creating markets for these products and potentially improving their livelihoods.

4.1.4 Technological Empowerment

Kan Singh employs traditional farming practices, avoiding the use of machines for spice processing and utilizing cow dung as fertilizer. While these methods are traditional, they are also a form of technology, promoting sustainable and environmentally friendly agriculture. Geeli Mitti Farms promotes natural building techniques and permaculture, which are innovative approaches that leverage traditional knowledge and sustainable technology for construction and agriculture. Whereas Gau Kasht utilize the cow dung wood as a building material is a unique and eco-friendly technology as it promotes sustainable construction practices that use natural resources without harmful chemicals or energy-intensive processes.

4.1.5 Improving Demand and Supply Chain

Families visit Kan Singh's farm to purchase organic food, vegetables, and spices, eliminating the need for market intermediaries. This direct connection between the producer and consumer streamlines the supply chain and benefits both parties while eliminating the middle men. By creating a rural tourism destination, Kan Singh has effectively increased demand for his products and services, thus improving the local supply chain. By offering a wide range of programs and activities related to sustainable living and eco-friendly construction, Geeli Mitti Farms creates a demand for knowledge and skills in these areas. It also supports the development of a supply chain for sustainable materials and practices. The farm's emphasis on sustainable tourism drives demand for accommodations and activities.

Additionally, it may source local and sustainable products for its operations, contributing to the local supply chain. Gau Kasht's promotion of cow-based products can stimulate demand for these items. This, in turn, may create opportunities for supply chain management and distribution of these products.

4.2 Constrains

Jor Ki Dhani has Infrastructural constraints as, the location of Jor Ki Dhani in a rural area in Sikar, Rajasthan, this might limit the accessibility for tourists and the supply chain for certain resources, also as a remote eco-village, it may face challenges related to basic infrastructure like roads, electricity, and connectivity. However Geeli Mitti Farms being a non-profit organization, the farm relies on donations and grants, which limits its financial resources and ability to expand or develop new programs, also the farm operates with a small staff and relies on volunteers, which restricts its ability to scale up operations. Remote location of the farm in Uttarakhand poses logistical challenges for transportation and resource procurement. Gau Kasht also faces similar constraint, the challenging terrain and the woods hinder the efficient transportation of equipment and supplies, affecting research and conservation efforts. The presence of significant human-wildlife conflict can pose challenges to protecting wildlife and their habitats.

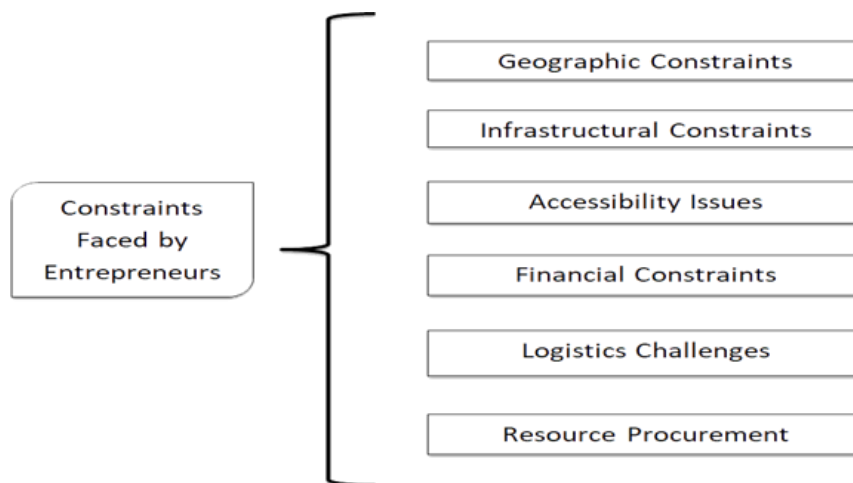


Figure 2: Constraints faced by Entrepreneurs Source – The figure is created by the Authors based on the interviews and Literature Review.

5 Conclusion

Atmanirbhar Bharat, the vision of a self-reliant India, is being realized through initiatives like the integration of Indian Knowledge Systems (IKS) with tourism. The case studies of Jor Ki Dhani, Geeli Mitti Farms, and Gau Kasht demonstrate how entrepreneurs are leading their communities towards self-reliance by focusing on economic empowerment, infrastructure development, community engagement, technological empowerment, and improving the demand and supply chain. These enterprises are not only contributing to the economic well-being of their communities but also promoting

sustainable and eco-friendly practices. They are effectively utilizing traditional knowledge and innovative techniques to drive economic growth while preserving the environment. However, they do face constraints related to geography, infrastructure, and financial resources. The integration of Indian Knowledge Systems and tourism is an important step in fostering self-reliance by creating economic opportunities, empowering communities, and promoting sustainable living. This approach aligns with the five pillars of Atmanirbhar Bharat, and these enterprises serve as inspiring examples of how self-reliance can be achieved at the grassroots level, contributing to the overall development of the nation. This will promote preserving natural resources, responsible tourism, and encouraging community participation in tourism development. By synergizing the Atmanirbhar Bharat initiative with the Indian knowledge system in the tourism sector, India can create a unique tourism identity, provide employment opportunities, preserve cultural heritage, and promote sustainable and responsible tourism practices.

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Exploring the Impact of Art on Audience's Mind (In the Light of Abhinavabhāratī)

Shikha Rajpurohit¹

¹Independent Researcher; PhD from Jawaharlal Nehru University

Abstract:

According to Indian perspective, art is meant to transcend individuality and lead towards universality. The author of Nāṭyaśāstra, Bharata argues that performing arts is the strongest means to achieve this kind of transcendence. Sight and hearing collaborate here to arouse a state of consciousness which is conceived intuitively in the spectator more forcibly than in any other form of art. This article is aimed at studying the impact of (performing) arts on its audience's mind. The success of any art-form depends as much on its reception among audience as it does on the talent of its creator. According to Abhinavagupta, the author of Abhinavabhāratī which is the only surviving commentary of Nāṭyaśāstra, relishing a rasa while watching a performance is a cognitive activity, and hence, studying its constituents is a matter of methodological discussion. This article consists of two parts. The first part is focused on discussing art as a subjective and cognitive experience and the second stresses the fact that this experience is necessarily rooted in joy and it ultimately, transforms the audience by giving them a kind of transcendental experience of identity with each other. While the experience of art is accompanied by physical factors, it is majorly a cognitive process and it eventually becomes meta-cognitive. This article explores this process of meta-cognition through art with a philosophical background. It studies how the audience employ their mind to construct an emotional experience for themselves. While watching a performance, the attention of audience constantly shifts between the pole of the visual and the pole of their understanding of it. This makes them active participants in this collective experience which is entertaining as well as transforming. Art is not meant to be contemplative, rather, it stimulates the audience to reflect and create an experience for themselves. Abhinavagupta explains the process of experience in art through subjective reflection. This also involves the various experiences and emotions that may not have been experienced in individual lives. The article explores the impact of the ambience and gathering on audience. It goes on discuss what could be the possible barriers for this kind of experience. According to Abhinavabhāratī, the utmost purpose of a performance is to please its audience. The effect of performance in the form of poetic-bliss is such that it has been considered akin to eternal-bliss. In Abhinavagupta's words, 'consciousness itself, consisting of pure joy is relished' (samvedanamevānandaghanamāsvādyate). This article aims to study the constituents of this experience of bliss. Interestingly, it is this bliss which leads to refinement of character. The worldly experience

may consist of multitude of emotions but poetry or art has to impart purely joy. The scope of this article includes the difference between feeling an emotion in real life and feeling it during a performance. The audience relishes what would seem to be a very painful experience otherwise. How are grief or anger transformed into a pleasurable experience for the audience? Abhinavagupta explains that the emotion of grief is transformed into the rasa of compassion and when the audience be fulfilled with it, they come to relish it, thus, elevating their minds. He argues that this empathy or compassion arises because of the latent impression (saṃskāra) of grief in one's own memory. The audience identifies this remembered grief with that of what they are experiencing through the performance, thus, establishing a correspondence in their minds. However, he argues that it is not the individual's grief that is being relished. It is the elevated sense of compassion with others which becomes enjoyable for them. This differentiates a poetic experience from common experience of the same emotions. This recognition of common emotional experience occurs only when one is capable of moving beyond their individual perspective to a more generalized sense of emotion. This is an important factor of relishing emotions such as, grief while watching a performance. The universality under discussion occurs in two ways, from the perspective of unity of the factors of performance and from the perspective of the collective impact that it leaves on the audience. Abhinavagupta argues that the aesthetic sensibility in the audience is nothing but the ability of entering into an identity with the poet's heart. (kaviḥṛdayāt ātmyāpatti yogyatā) The concept of sādharmaṇīkaraṇa emphasizes the value of identification, which results in sublimation and extension of consciousness. This concept includes all the three factors in the aesthetics: the creator's experience, the creation and the audience's response to it. The mind of audience first becomes attuned to the emotional situation expressed through the performance 'hṛdayasaṃvāda'; then gets completely absorbed in its portrayal 'tanmayībhavana'; and finally results in aesthetic experience 'rasānubhava'. However, he agrees that not everyone can respond to all the emotions throughout the performance. (sarvasya na sarvatra hṛdayasaṃvādaḥ). In Krishna Chaitanya's words, 'the circle is complete when aesthetic experience makes the reader a more sensitively functioning entity in the world, with enriched and refined activities.' And in this manner, it transforms the audience.

Enhancing Mental Health: Exploring the Role of Spirituality in Prevention and Recovery

Jayant Athavale¹, Sean Clarke², Shweta Clarke¹

¹Maharshi University of Spirituality

²Maharshi University of Spirituality and Spiritual Science Research Foundation

Abstract:

According to the World Health Organisation (WHO), approximately one in eight individuals worldwide experiences a mental disorder, often accompanied by high relapse rates. Recognizing the limited accessibility to effective care, there is a growing need to explore alternative approaches to mental healthcare. This study, conducted at the Spiritual Research Centre of the Maharshi University of Spirituality, aimed to investigate the impact of spiritual practice on overcoming mental disorders and empowering patients towards self-sufficiency.

Utilising Aura and Energy Scanners, we assessed the auras of mentally ill patients, revealing heightened negativity compared to individuals with normal mental health. Through spiritual research, we identified specific mantras and self-healing remedies that promote positivity in one's aura and chakras (subtle energy centers in the body).

In our intervention, mentally ill patients were exposed to audio recordings of the mantras while actively chanting along for 40 minutes. Pre- and post-exposure aura and chakra measurements demonstrated a significant increase in positivity. Additionally, a 15-minute salt water healing treatment reduced negativity in their auras by an average of 50%. Following these spiritual interventions, patients reported increased mental stability. Remarkably, sustained chanting of mantras and saltwater treatment resulted in complete recovery from a range of mental illnesses, including depression, suicidal thoughts, addictions, schizophrenia, obsessive-compulsive disorder, and psychotic episodes. Recovery time varied from several days to several months, depending on the severity of the condition.

The encouraging results of these methods have garnered testimonials from patients of diverse cultural backgrounds, showcasing their efficacy in reducing relapse rates. Furthermore, these spiritual healing treatments have shown to decrease stress levels, improve interpersonal relationships, and aid individuals with schizophrenia in reintegrating into daily life.

This pilot research study aims to initiate a dialogue among medical health practitioners and researchers, encouraging the exploration of spiritual measures as complementary approaches to conventional medicine for the prevention and cure of mental health issues. By raising awareness about the positive impact of spiritual practices on mental well-being, this study intends to stimulate further discussion and

innovation within the medical community, fostering holistic and innovative approaches to mental health care.

Effects of Yoga mental health measures and sleep quality among health care professionals during COVID-pandemic

Kashinath Metri¹ , Satypriya Maharana²

¹Central University of Rajasthan

²Swami Vivekananda Yoga Anusandhan Samsthan, Bengaluru

Abstract:

Background: Healthcare professionals (HCPs) have an increased risk of anxiety, depression and stress, in addition to COVID-19 infection risk during the COVID-19 pandemic. Scientific evidence suggests that yoga effectively improves various mental health measures among caregivers and nurses. Objective: To assess the efficacy of integrated yoga intervention in mental health enhancement among HCPs working during the COVID-19 pandemic. Method: A quasi-experimental trial of one hundred ten HCPs, including doctors and nursing staff, with an age range of 20-65 years, were recruited through a convenience sampling method into two groups (yoga-55 & control-55). The yoga group received weekly tele-yoga sessions and 30-minute self-practice at home. The control group followed routine activity. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), perceived stress, COVID-related anxiety, sleep quality, quality of life and preservative thinking were assessed before and after intervention. Results: The yoga group showed significant improvement in stress, sleep quality and anxiety measures after one month compared to baseline. No change in the control group was noticed. At one month, improvement in the yoga group was significantly more significant than the control group's. Conclusion: There is a significant improvement in physiological, psychological, sleep quality and quality of life among healthcare workers after yoga interventions.

Defining Dark matter: Grounded theory approach to ‘Paazh’ the void origin of cosmos in Indian philosophy

¹Arunvel Thangamani

¹INDEPENDENT RESEARCHER

Abstract:

Alternate directions such as super-fluidic vacuum theory are gaining attention in astro-physics, with a view to address dark matter, the inconsistency between gravitational effects and the visible mass in galaxies. They primarily consider the non-removable background of cosmos, the fundamental physical vacuum as a specialty medium that participates in gravitation and therefore characterizing this non-removable background is of paramount importance. Indian philosophical texts mention of a primordial state of space, where no matter exists, which is endowed with energy and consciousness to evolve as the cosmos. Siddha tradition, an essential branch of indian knowledge system, is a good area to look for pertinent concepts and attributes, owing to its longevity and absence of mythological dimension. In this study, applying grounded theory approach, 72 verses of siddha tradition were shortlisted and studied, to arrive at 38 key-words, and 11 concepts that surround the term ‘paazh’ which refers to the primordial absolute space. In addition, mainstream directions such as space-time quantum fluctuations, space-time elasticity or curvature, singularity, higgs-field etc., are treated as constant comparison samples and have been looked for corroboration presence or absence. Our recommendations to the hypothesized dark matter includes, 1. considering space-time continuum to have an inherent potential energy and corresponding force that participates in gravitation, 2. adjusting stress-energy tensor of general relativity to accommodate such a force or pressure, 3. assigning quantum scale vibration and thereby integrating time in space continuum, 4. a no-matter primordial space wherein localized energy intensification occurs with periodicity, 5. such a formless energy state surrounding cosmos, 6. absence of any big-bang but presence of infinite quantum energy spikes in primordial state of space resulting in fundamental particle emissions and 6. consciousness as an inherent non-computable quality of primordial space.

Pedagogical Implications of Indian Knowledge System (IKS) for Modern Education

Vijay Makwana¹

¹Charotar University of Science and Technology, Changa (Anand)

Abstract:

This research work explores the pedagogical implications of integrating the Indian Knowledge System (IKS) into modern education. Drawing upon diverse sources and scholarly insights, this paper examines the potential impact of IKS on contemporary educational practices. It discusses how IKS, with its rich philosophical and practical traditions, offers valuable perspectives and methodologies for enhancing teaching and learning experiences. The abstract highlights the holistic nature of IKS, emphasizing its ability to nurture the intellectual, emotional, physical, and spiritual dimensions of learners. It further discusses the relevance of IKS principles such as experiential learning, critical thinking, ethical values, and mindfulness in promoting well-rounded education. The abstract concludes by emphasizing the significance of integrating IKS into modern education to foster a comprehensive and balanced approach that addresses the diverse needs of students in the 21st century.

Can music help service sector employees' well-being? A transformative consumer research perspective

Abhisek Verma¹

¹Indian Institute of Management, Ahmedabad

Abstract:

Affordable music streaming technologies have significantly helped employees to consume music for their well-being (Sinclair et al., 2019). Working professionals who struggle to keep pace with an increasingly competitive workplace consume music to ease boredom and loneliness. Human resource management (HRM) is adopting similar exercises to check employees' boredom and anxiety and engage them toward company goals. Therefore, this study applies a consumer re-search perspective to learn the impact of music on three hundred working professionals aged 20-45 in Ahmedabad. The results are primarily subjective, and most employees across ages and gender believe positively about music in the workplace. While sizeable believe listening to music does not help ease workplace uncertainty.

Monastic Wisdom for Mental Wellbeing: Insights from the Classical Text Jīvan Mukti Viveka

Judu Ilavarasu¹

¹Humanities and Liberal Arts in Management, Indian Institute of Management Kozhikode.

Abstract:

This work explores the application of classical Indian text, Jīvan Mukti Viveka, to contemporary mental health practices. It enumerates three means of achieving freedom: Tattva jñānam (knowledge of reality), Vāsanā kṣayam (reduction of latent impressions), and Mano naśam (silencing of mind). The text emphasizes the simultaneous practice of these three means for effective results. This approach is similar to the challenges faced by mental health seekers, where the participant's disposition towards treatment is crucial. The suggested approach could potentially enhance adherence to treatment, improve treatment receptivity, and prevent re-lapse. The role of triṣaṇa (sattva, rajas, and tamas), a personality model that can help interpret thoughts and adjust behavior, is also discussed. This work suggests that applying the Jīvan Mukti Viveka framework and understanding of triṣaṇa could provide a holistic approach to managing mental health issues.

Managing Multicultural Exposure: Lessons from Indian Temples

Sooraj Ms¹, P. R. Padmakumar¹

¹Amrita School for Sustainable Development, Amrita Vishwa vidyapeetham, Amritapuri, India

Abstract:

The intricate coexistence of highly diverse philosophies, cultures, and worldviews characterizes contemporary society. These worldviews and philosophies not only differ widely, but they also frequently clash with one another, resulting in conflicts. The escalating global trend of violence motivated by religious beliefs and convictions is especially concerning (Gorur et al., 2021). These conflicts can be traced back to historical and civilizational factors; however, it is critical to recognize that psychological attitudes play a significant role in their manifestation (Abu-Raiya 2013). According to social identity theory, social identity dominates economic and political factors in intergroup conflicts (Bochatay et al., 2019).

Exposure to multicultural environments has the potential to affect a person's psychology (Chao et al., 2015). Multicultural exposure has the potential to improve an individual's creativity and acceptance. It should be noted, however, that it can also lead to intergroup bias and intolerance of outgroups (Chao et al., 2015). The primary goal of this research is to delve into Hindu temples and investigate the philosophical underpinnings of Indian Knowledge Systems in order to address the implications of multicultural exposure. Outgroup tolerance, a critical attitude that promotes success in multicultural settings. It is heavily influenced by an individual's religion and its underlying philosophy. Theodiversity in Hindu temples, combined with the wisdom embedded in their scriptures, provides a framework that fosters coexistence. Understanding and embracing the age-old framework of Indian Knowledge Systems is critical for promoting harmony and mutual understanding among diverse communities in the face of escalating intergroup conflicts.

Effect of Sanlekhana Sadhana on Death Anxiety among Elderly Adults – A Cross sectional Study

Harsha Bora¹ , Ritika Jain² , Ritika Sharma

¹SVYASA University, Bengluru

²Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Abstract:

Introduction: Death anxiety is defined as an unusual fear of death along with feelings about the horror of death or anxiety when thinking about dying process or things and events happening after death. It is an unavoidable stage in life which all humans should face at some point in their life, but this issue is much higher in old people since they cannot expect to live as long as younger people. Amongst many spiritual practices, Jainism follows process for peaceful and suffering free death, for that every day they follow Sanlekhana Sadhana (Meditation). **Aim & Objectives** - The purpose of the study was to observe the impact of Sanlekhana Sadhana on Death Anxiety in elderly adults. The objective of the study was to compare the death anxiety in practitioners and non-practitioners in the scale of Death Anxiety. **Method & Materials** - Eighty healthy male and female elderly adult subjects with age range 45 to 60 years were recruited in this study, among which forty subjects were Sanlekhana Sadhana practitioners with more than one year sadhana experience. The remaining forty was non practitioners. The participants were recruited from all over the country those who are practitioner and those who never introduced to practice. The demographic information of all participants were obtained and each participant and Death Anxiety Scale by Santosh Dhar, Savita Mehta And Upinder Dhar filled by participants. **Result** – SS practitioners shows lower death anxiety, a significant difference existed between practitioner group and non-practitioner group ($t = 3.24$; $p = .026$). **Conclusion** – SS practice may facilitate anxiety related death as presented in the current study. SS practice which is mentioned in Jain scriptures is accessible on modern scales. SS practice is reducing the death anxiety in healthy elderly adults, so that it may show changes in participant's physical or emotional ailments. It can also be concluded that non meditational group of elderly adults experienced higher death anxiety compared to meditational group of elderly people.

LJaya Optimization based Feature Selection Approach for ADHD Classification

Samrudhi Mohdiwale¹, Mridu Sahu ², Shivangi Diwan³().

¹ Institute of Technical Education and Research, Siksha O Anusandhan University

² National Institute of Technology Raipur), G.R. Sinha (International Institute of Information Technology, Bengaluru

³ NIT Raipur

Abstract:

ADHD, categorized by the lack of attention and focus, is one of the most common cognitive disorders. Since EEG signals carry wide-ranging insights about cognition skills, the potential of using EEG signals to detect ADHD has a significant capability. The state of art methods of detection and treatment of ADHD suffer from the repetitive modules of inattentive targets with a lack of motivational aspect. With the introduction of serious games, engagement and motivation in task is no longer an obstacle. Serious games are specially designed for primary purposes rather than entertainment. These games create a unique environment containing interactive and engaging modules specially designed for patient centric cognitive assessment. FOCUS is one of the serious games designed for ADHD classification. The EEG signal recorded during the FOCUS gameplay shows ADHD patient have lower attention and different EEG band activity observed in ADHD patient than Non-ADHD subjects. In this work, we have analyzed different EEG Frequencies along with some derivative frequencies that can be useful to categorize ADHD and Non-ADHD Patients. The dataset includes eight subjects having ten sessions for each subject. For each session of recording, nine different frequency-based features are extracted. Further, to identify the relevant features which is having higher impact on classification, feature selection technique has been used. In this work, we have proposed Logical Jaya Optimization based feature selection method for classification of ADHD Patients. The objective function is designed to maximize classification accuracy. The study uses the wrapper method of feature selection and classification accuracy used as the objective function which needs to be maximized. Significant improvement in the accuracy has been achieved by applying the Logical Jaya Optimization algorithm. The results show that, by applying the LJaya feature selection, we have achieved classification accuracy 99.46%. The study also gives the set of relevant features that helps to improve the accuracy of classifier. The results obtained from the study are also compared with existing work on the dataset. Comparison with existing work also shows the better performance of wrapper method-based LJaya algorithm of feature selection for classification of ADHD Patients.

Short term add-on Yoga intervention in adolescent depression improves emotionality and wellbeing: A psychometric and ERP study

Suma Bhaskar¹, Rahul Venugopal¹, Lopamudra Naik¹, Arun Sasidharan¹, Ramajayam Govindraj¹, Bindu M Kutty¹, Rajendra Kiragasur Madegowda¹, Hemant Bhargav¹, Ravindra Pinna Nagendra¹

¹National Institute of Mental Health and Neurosciences (NIMHANS)

Abstract:

Adolescent depression is the leading cause of disability and a public health concern globally (1). Despite effective pharmacological and psychotherapeutic approaches, the symptoms are recurrent and persistent (2). Also, current treatments do not address the impaired attention, emotion perception & working memory that negatively impact an adolescent's day-to-day functions (3). Yoga intervention has been shown to be effective in reducing depression symptomatology in both adults and adolescents (4,5). Though increased GABA, BDNF levels, and enhanced parasympathetic activity, etc., are proposed as mechanisms associated with the beneficial effect of Yoga for depression, there are no studies exploring the underlying neurophysiological mechanisms. Therefore, the present pilot study explores the possible neurophysiological mechanisms.

Understanding bhavnatmak buddhi (emotional intelligence) through the paradigm of ayurveda

Amrita Sharma¹ , Chandershekhar Sharma².

¹BAMS, MD

²BAMS, MD

Abstract:

Ayurveda is a comprehensive, distinctive Vedic science that covers all the facets of health. This ancient science contemplates the state of health as a parameter in equipoise with a healthy mind, intellect, and senses in addition to all physiological parameters. Apart from the physical self, the mental well-being state depicts one's qualified ability to live happily, work fruitfully, and be persuasive. The Upanishads describe intelligence (prajna or vijanana) as the essence of the eternal self, reflected in the body as discernment. According to the Vedas, emotional intelligence is also referred to as 'Chitta Shakti'. The Vedic scriptures extensively talk about buddhi (intelligence) and its role in health conservation. Buddhi (intelligence), the highest aspect of nature in the body, is a crucial component of mental health that illustrates the capacity to change course in various life circumstances. It encompasses the ability to understand, manage, and express emotions effectively. It determines one's ability to see and realize the potential to live in harmony with oneself and others. The paper focuses on understanding the concept of Bhavnatmak Buddhi (emotional intelligence), which is a big part of human intelligence that brings creativity and add morals and ethics to the value of life. As per Ayurveda, Bhavnatmak Swasthya, or emotional health, depends on the state of Dhee Dhruti and Smriti. These three parameters render the power of chintyam, vicharyam, sankalpam, uhyam, and dhyeyam that denotes the right perspective on life in terms of thinking, being judgmental, logical reasoning, and fulfilling the goals of life. The concept of life as per Ayurveda is the complex combination of Sharira (body), Indriya (senses), and Atma (soul) governed by the Panchamahabhuta (five elements). The Bhavnatmak Buddhi plays a vital role in different states of the body and mind. Its rational state brings happiness, joy, and the feeling of well-being and health. Its demented state disturbs the three humors (Vata, Pitta, and Kapha) and Trigunas (the three qualities of life, viz., Satva, Rajas, and Tamas), in which Rajas and Tamas dominate. Dominance of Rajas and Tamas dosha hampers decision-making and results in impairment of memory and emotional imbalance, which arises negative feelings like Kama (desire), Krodha (anger), Lobh (greediness), Moh (illusion), Irshiya (jealousy), Mann-Mada (arrogance), Shoka (grief), Chinta (worry), Udvega (anxiety), etc. Ayurveda has a beautiful insight into dealing with the causes and solutions to find how we can curtail these disorders and make our lives happy. According to Ayurveda, the concept

of mind (Manas Prakriti) is comprehensive and significantly generates emotions in life. Manas prakriti is considered non-static and changes with the waves of mental thoughts and emotions. It's derived from various components like Buddhi, Ahamkara (ego), and Chitta (consciousness). Mano doshas (rajas and tamas) and Manas Prakriti (mental constitution) are responsible for the experiences and interpretations of life that differentiate an individual for the ability to recognize, comprehend, appraise, and use the power of emotions as a source of human inspiration and knowledge and influence one's capability to learn and interact with the environment. With the fast-changing technology-oriented world, health issues related to emotional imbalances are growing rapidly. It has been observed that people with higher emotional intelligence lead a positive quality of life, effectively managing conflicts, being able to navigate relationships and situations, and making decisions guided by wisdom and empathy. People get increasingly better at handling emotions, impulses, and performance with a higher emotional quotient. Thus, emotional intelligence is considered an essential tool for physical health and psycho-spiritual health, while people with low emotional intelligence tend to develop mental, emotional, psychopathological, and spiritual issues in life. Emotional intelligence has been proven to be a resilient factor in mental health. A deficiency of emotional intelligence can have a variety of detrimental psychosocial and physical outcomes for individuals that may require therapeutic intervention from time to time. People with low emotional intelligence suffer from mental disorders, lack of empathy, anxiety, anger, hostility, depression, impulsiveness, vulnerability, weak defense mechanisms of the body, and have problems understanding their emotions more than others. These issues are not new but have existed for a long time. Low emotional intelligence leads to drug and alcohol abuse, bipolar disorder, eating disorders, bulimia, schizophrenia, and substance abuse disorder. Ayurveda elaborates on the mental and emotional disturbances leading to psychological disorders such as Apsmara, Unmada, Atatvabhinivesh, Grahabadha, etc. As Ayurveda is focused on attaining physical and mental well-being, the texts have elaborated various means adapted for the balance of emotions and sustenance of emotional health. These methods include pharmacological and non-pharmacological approaches to cure and balance emotions. Emotional awareness can be evolved from childhood and cultured at later stages of life. Lifestyle management and trends can grossly change the emotional quotient. Ayurveda is among the rare sciences that emphasize lifestyle management to cure many diseases and disorders at the physical level and transform the emotional and spiritual grounds. These parameters are of utmost importance when it comes to emotional health. The paper also highlights the sublime concepts of Ayurveda that describe the means to build emotional intelligence. These concepts includes Dinacharya and Ritucharya (daily and seasonal regimens) are the tools that give a glimpse of a disciplined lifestyle and reinforce positive emotional health. Sadvritta is another means to follow a good regime in life, in other words, a good code of conduct that shall be followed in personal, social, religious, and practical dealings, which aids in increasing the mental faculties. Achara rasayana is the rejuvenating attitude that implies moral,

ethical, and benevolent conduct, personal and public cleanliness, truth, nonviolence, mental and personal hygiene, devotion, compassion, and a yogic lifestyle. Medhya rasayana is a group of nootropic herbs that enhance biological nourishment of the brain, produce tranquility of mind, and improve memory, concentration, emotional health, and intellect. Satvaavjaya Chikitsa is a treatment modality designed to increase the sattva. It is achieved through Jnanam (knowledge), Vijnanam (analytical thinking), Dhairya (courage), Smrti (memory), and Dharana (concentration). Using the Ayurveda detoxification technique of Panchakarma can be beneficial to restore the normalcy of intellect, sense of faculties, and mind and achieve emotional balance. Treatment through divinity by Daivavyapashraya Chikitsa, which is based on the modality of a divine power through mantra chanting (enchanted hymns), Ausadhi and Mani dharna (wearing sacred herbs and precious gems), Mangala Karma (propitiatory rites) like bali (oblations), homa (sacrifice), Upahara (offerings), Niyama (vows), Prayascitta (ceremonial penitence), Upavasa (fasts), Pranipata (surrender), etc. Topical application or fumigation of aromatic oils like sandalwood oil, camphor oil, cedar oil, rose oil, jasmine oil, etc. has been proven beneficial to enhance emotional, cognitive, and psychological well-being.

Varied responses to Meditation Training: Impact of Self-improvement motivation

Ramya Neelamegham¹, Vipina Valsan², Vimisha Valsan³, Shyam Diwakar⁴

¹ Amrita School of Business, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala

² Department of Electrical and Electronics Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala

³ School of Spiritual and Cultural Studies, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala

⁴ Amrita Brain Mind Centre, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala

Abstract:

Meditation is a core element of Indian Knowledge Systems (IKS). IKS emphasizes yamas and niyamas, self-effort and motivation in meditation practice. Further, IKS offers numerous meditation techniques such as awareness, mantra chanting, visualization. By contrast, academic research focusses on mindfulness meditation and its benefits. There is very limited research on motivation needed for meditation. This study examines the impact of a large-scale meditation intervention with over 5000 Indian students, investigating who benefits most, how they benefit, and factors influencing them. A mandatory meditation course introduced students to a novel meditation technique based on IKS. Using pre-test/post-test design, data was collected via online questionnaires before and after the meditation course. Participants' self-improvement motivation, cognitive flexibility, distraction levels, and emotional awareness were measured. Results revealed that students with high self-improvement motivation gained the most from meditation training. They demonstrated improved cognitive flexibility, emotional awareness, stress resilience, and reduced distractions compared to low-motivated peers. Moreover, family background in spirituality and prior meditation experience influenced self-improvement motivation, enhancing the training's benefits. The study highlights the significance of individual motivation in effective meditation training and emphasizes the need for efficacious pedagogy to boost motivation for all students. These findings provide empirical validation to IKS wisdom

Virtual Reality assisted Mantra Meditation

Durgesh Ameta¹, Ankita Garg¹, Laxmidhar Behera¹, Varun Dutt¹

¹ IKSMHA Centre, Indian Institute of Technology Mandi, Kamand, Mandi, India

Abstract:

Meditation and other similar practises help people improve their emotional stability, awareness, and attention. The practitioners of such activities may benefit from virtual reality (VR) as they might struggle with attention or concentration. Among numerous such investigations into the suitability of VR for meditation, very few have attempted to assess the efficiency of VR on Audible mantram repetition (AuMR). In this study, we created two groups, named test and control, each comprising 10 members. The test group undertook a ten-minute session of mantram meditation, while the control group remained idle. All participants in both groups experienced the identical immersive 360 virtual reality (VR) environment. Measurements of heart rate variability (HRV) and electroencephalogram (EEG) signals, along with the administration of questionnaires (DASS-21, PANAS) and cognitive assessments (N-back and Stroop task), were conducted prior to and following the intervention in both groups. The purpose was to evaluate modifications in participants' mental states and cognitive capacities. Paired t-test results showed that the DASS parameters reduced significantly, while the HRV parameters, EEG features and accuracy in N-back test substantially increased in the test group as compared with the control group. Also, for PANAS, the positive affect increased and the negative affect showed reduction which was statistically significant for the experiment group. This study suggests statistically significant efficacy data and that a larger randomized study is feasible to test the potential of the AuMR in clinical settings.

Posters

‘Paramanu’, the primordial spinning quanta of super-fluidic space-time: The source of gravitational wave phenomenon

Arunvel Thangamani¹

¹ Independent Researcher, Chennai TN 600028, India

arunvel.t@gmail.com

Abstract:

Tracing selected indian philosophical texts, this work proposes space-time as specialty super-fluid with inherent pressure and plank scale vibrations. Formation of fundamental particle from space-time, and its spin is proposed as a fluid dynamic finite volume separation event following energy conservation principle. Gravitational waves, ripples in space-time, is derived as the pressure-shear-momentum interaction between space-time superfluid and its ‘spinning finite volume system’. A set of fluid dynamics equations are developed to represent such a ripple generation. Further, consciousness, a not fully understood phenomenon in scientific literature, is suggested as the inherent quality of super-fluidic space-time, remaining beyond computable physics, reflecting via local resonant vibration events, causing the formation of fundamental particle of definite properties. In effect, this work proposes, gravitational waves are also inherently conscious, or in other words, follow pattern, precision and regularity attributed to the fundamental nature of the super-fluidic continuum. Leveraging this scheme, a first-principle definition for gravitation, as a function of super-fluid’s inherent pressure, is also evinced herein. The contributions of this work include, 1. expressing gravitation as quanta diffusion and energy transfer from fundamental particle into super-fluidic pulsating pressure continuum, 2. expressing gravitational waves as a fluid dynamic interaction between super-fluidic space-time and matter, and 3. proposing cosmos origin as a conscious event arising from super-fluid’s local pressure-energy pulsation peaks.

Keywords: Space-time, Gravitational waves, Super-fluid, Consciousness, Bose-Einstein condensate, Navier-stokes

From Ancient Practices to Brain Transformations: Profound White Matter Alterations in Vedic Pandits.

Uttam Kumar¹ & Kalpana Dhanik¹

¹Department of Advanced Spectroscopy and Imaging
Center of Biomedical Research, Lucknow (Uttar Pradesh), India

Abstract:

This study utilized diffusion tensor imaging (DTI) to investigate white matter microstructural differences in professionally qualified Pandits, individuals renowned for their exceptional memorization and recitation abilities. A cohort of 50 male volunteers (aged 21-28 years) participated, including 25 Pandits and 25 matched controls. The study aimed to assess whole-brain fractional anisotropy (FA) values, providing insights into training-induced alterations and their implications for the Pandits' cognitive skills. Professionally qualified Pandits underwent rigorous Vedic training, commencing at a mean age of 10.58 years, dedicating 10 years full-time and continuing daily practice while working as Vedic teachers. DTI analysis revealed significant enhancements in white matter microstructure throughout the brain in the Pandit group compared to controls. Notably, these enhancements were observed in specific regions including pre- and post-central regions, mid- and posterior cingulate regions, and the caudate nucleus. These regions are known to play critical roles in motor planning and execution, attentional and emotional processing, as well as procedural learning and cognitive control, respectively. The training-induced improvements in white matter microstructure within these regions may contribute to the Pandits' exceptional cognitive abilities. The enhanced integrity of the pre- and post-central regions potentially facilitates their refined dexterity in memorization and recitation. The heightened integrity in the mid- and posterior cingulate regions may enhance focus and emotional engagement during Vedic practices. Moreover, the improved microstructure of the caudate nucleus may underlie their enhanced learning and executive functions. These findings shed light on the neurobiological adaptations resulting from intensive Vedic training.

Keywords: Professionally qualified Pandits, Vedic training, diffusion tensor imaging, fractional anisotropy, white matter microstructure.

Efficacy of Saraswata Ghrita in Alzheimer's disease given through oral and nasal routes – An Exploratory clinical trial

Robin Bafdal¹, Pramod Yadav¹ Pradeep Kumar Prajapati² PRAMOD YADAV(2), PRDEEP KUMAR PRAJAPATI

¹Department of Rasashastra and Bhaisajya Kalpana, All India Institute of Ayurveda, New Delhi-110076, India

²Vice-Chancellor, Dr. Sarvepalli Radhakrishnan Rajasthan Ayurved University, Jodhpur, Rajasthan-342037
Efficacy of Saraswata Ghrita in Alzheimer's disease given through oral and nasal routes – An Exploratory clinical trial

Introduction: Ayurveda considers the nasal route (Nasya) to be the best for the management of diseases arising in the head and neck since it is the gateway to the brain. In order to assess this hypothesis, an exploratory study was planned to evaluate and compare the effect of a polyherbal oleaginous preparation Saraswata Ghrita administered through nasal and oral routes in improving the quality of life of patients suffering from Alzheimer's disease.

Material and methods: The study was open open-label Randomized Clinical Trial approved by IEC and registered prospectively in CTRI. 39 patients were divided randomly into three equal groups, viz. Nasal – Group A (1.34ml each nostril BD), Oral – Group B (dose 6gm BD), and one Group – C for observation only. Conventional medications were allowed to continue in all the groups. These patients were diagnosed cases of AD as per DSM IV criteria and the assessment was done on ADAS-cog and QoL-AD scale.

Results: On the basis of ADAS-cog and QOL-AD scale, Group A&B showed statistically significant improvement on most of the variable than Group-C. Amongst group A&B, Group-A was the found to be more effective

Discussion: A comparison of the results shows that Nasya of Saraswata Ghrita was found better than oral administration. The Medhya Ghrita gets absorbed through cells of the lining membrane and then comes into circulation through local capillaries and veins. So, the drug reaches at target quickly than oral administration. However, further studies with biological markers need to be carried out to substantiate these findings

Sarvaṃ Śabdena Bhāsate: Sound as a conduit to consciousness and well-being

Chandrika Kamath¹, R. Venkata Raghavan², and Chinmayananda A¹

¹ Indian Institute of Information Technology, Dharwad, India

² Indian Institute of Technology, Bhubaneswar, India chinmay@iiitdwd.ac.in

Abstract:

This study explores the intricate relationship between sound and consciousness within the context of various branches of Indian Knowledge Systems (IKS). The paper delves into the diverse definitions and perceptions of sound and consciousness as presented in Yoga, Upaniṣads, Saṅgīta śāstra, and Vyākaraṇa. Notions of sound as both a means of perceiving the external world and as well as a conduit to the supreme consciousness are examined. Drawing evidence from various theories of cosmogony in IKS as well as yogic practices, the paper establishes the special connection between sound and consciousness during both the evolution (sṛṣṭi) and involution (pralaya). The stages of sound manifestation—Parā, Paśyantī, Madhyamā, and Vaikhari—are explored, wherein Parā represents the unmanifest sound realised in the supreme consciousness. The study also discusses the role of sound in the dissolution of men-tal impressions (vāsanā) and highlights the efficacy of sound therapy and music therapy on the mind and consciousness. By investigating the relationship between sound and consciousness, this work aims to contribute to the understanding of sound as a tool for therapy and general well-being, potentially paving the way for further exploration and practical applications in the future.

Keywords: Consciousness, Nāḍānusandhāna, Indian Knowledge Systems, Auditory Perception, Yoga.

Background: Human beings have five sense organs through which we perceive the world. One of the objects of perception is the gross sound (sthūla śabda), which we perceive through our auditory sense. There are other subtle sounds (sūkṣma śabda) which are not ordinarily heard. Some of the Indian śāstras also identify a certain anāhata nāda, which is eternal, unperceivable, and is not produced in the same way any gross sound is produced.

The notions of sound and consciousness have been understood differently in different branches of Indian Knowledge Systems (IKS). Different theories of cosmogony have also been proposed in which sound and consciousness play a major role. The special relation between sound and consciousness has

been studied and employed in different traditions for the development of the human psyche such as Japa (Chanting), Mantra Yoga, Classical Music and Sound Therapy in recent days.

In this work, we study and relate the different definitions and notions of sound and consciousness provided in Yoga [1], Major Upaniṣads [2], Minor Upaniṣads on Yoga [3], Sangīta śāstra (Indian Musicology) [4] and Vyākaraṇa (Grammatical tradition of Sanskrit) [5]. We specifically investigate a special “proximity” (compared to other senses of perception) between sound and consciousness. It will be substantiated that different modes of sound form a conduit to the supreme consciousness in the evolution phase (sṛṣṭi) of the observed universe (with respect to an observer) as well as in the involution phase (pralaya) where the individual tries to attain the supreme consciousness.

In the Taittirīya Upaniṣad [2], it has been stated that ākāśa is the first basic element created by Brahman (2.1.1), which is the supreme consciousness. Ākāśa is also attributed with a quality of subtle sound (śabda tanmātra), which finally manifests as different gross sounds. All other basic elements evolve starting from ākāśa in succession, finally creating the universe we perceive. We observe that in this chain of evolution, the subtle form of sound is the nearest evolute to the supreme consciousness. Similar notions of proximity and the relations between different notions of sound like nāda and śabda are studied from other śāstras.

The Grammatical, Tantric, Yogic, and Upanishadic traditions have postulated that speech has four stages of manifestation: Parā, Paśyantī, Madhyamā and Vaikharī. Parā is the unmanifest sound realised when one reaches the supreme consciousness, while Vaikharī is the perceivable form. The intermediate forms are only perceivable to yogis. The different stages are also said to manifest in the different cakras according to texts on Yoga.

Likewise, during the involution phase as well, we find the special connection between sound and consciousness supported by scriptural authority as well as yogic practices. The final stage of realisation of the supreme consciousness consists of the destruction of one's own latent mental impressions, which is termed as vāsanākṣaya. This is said to be the result of Nāḍānusandhāna, concentration on the subtle sound, in few Minor Upaniṣads on Yoga. Nāḍānusandhāna is in turn a result of “Ajapa” Japa, which is an effortless mental chanting of mantras. In the course of nāḍānusandhāna, the practitioner is said to experience subtle sounds similar to the sounds of bell, conch, vīṇā, flute, mridanga, and others. This approach of involution involves different forms of sound at various levels of sophistication. Other approaches to involution are also mentioned in Yogasūtra, Yogopaniṣads, as well as the Major Upanishads, which include the chanting and meditation on the ultimate sound “OM”.

Finally, the implications of this proximal relation of sound with consciousness will also be discussed. Efficacy of Sound Therapy and Music Therapy have been scientifically validated with Electroencephalography (EEG) and brain scans [6,7]. However, it is still unclear how and why sound works on the mind and consciousness. This study tries to delve into understanding the interaction

between various forms of sound and consciousness, based on different branches of IKS. This study can galvanise more research on using sound as a tool, for not only therapy but as a means to general well-being. Letters of the alphabet (akṣara) and musical notes (svara) have been associated with particular colours and emotions [4]. Delving into isomorphisms between sound and other aspects of the universe with this understanding of the proximity of sound and consciousness, can have many practical benefits for the wellbeing of humanity.

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Music and Attentional Processes: Investigating the Effects of Music on Selective Attention, Divided Attention, and Sustained Attention

Mayank Tiwari¹

¹Director, Research and Development Wing, Guidance Clinic India Pvt. Ltd.

Abstract:

This experimental study aims to examine the impact of music on attentional mechanisms, including selective attention, divided attention, and sustained attention. The study seeks to contribute to the understanding of how music affects cognitive processes and potentially enhance attentional performance. A controlled laboratory experiment will be conducted with participants randomly assigned to music and non-music conditions. The participants' attentional processes will be assessed using established attentional tasks, including the Stroop task, the dual-task paradigm, and the sustained attention to response task (SART). The collected data will be analysed using appropriate statistical methods, such as analysis of variance (ANOVA), depending on the nature of the variables. The main analysis will involve comparing the performance (reaction time and accuracy) of participants in the music condition with those in the non-music condition. Additional analyses may include exploring potential interactions with participant characteristics (e.g., musical expertise, preferences) and assessing any potential moderating effects. Statistical significance will be set at $p < 0.05$, and effect sizes will be reported to determine the practical significance of the findings. The study's findings may provide valuable insights into the potential benefits of music in attentional processing and inform practical applications in various domains.

Keywords: Music, Attention, Attentional processes, Selective attention, Divided attention, Sustained attention

To trace the texts that refer to Indian mental health, from the point of view of the Indian knowledge tradition.

Mayank Tiwari¹

¹Director, Research and Development Wing, Guidance Clinic India Pt. Ltd.

Abstract:

To explore and trace texts that refer to Indian mental health from the perspective of the Indian knowledge tradition. The Indian subcontinent has a rich and diverse history of knowledge systems that have delved into the understanding of the human mind and mental well-being. This study focuses on investigating the textual sources that shed light on Indian mental health practices, philosophies, and concepts. Drawing upon the vast repository of ancient Indian texts, including the Vedas, Upanishads, Yoga sutras, and various philosophical treatises, this research aims to provide a comprehensive analysis of the Indian knowledge tradition's perspective on mental health. These texts, dating back several millennia, offer profound insights into the understanding and management of mental well-being in Indian society. The research methodology involves an in-depth examination of primary and secondary sources, including translations and commentaries, to identify key texts that discuss mental health from an Indian perspective. By exploring these texts, the study aims to elucidate the foundational principles, theories, and practices that form the basis of Indian mental health traditions. The analysis will encompass various aspects of mental health, including concepts of psychological well-being, emotional balance, cognitive processes, and spiritual dimensions. The study will also investigate the interconnections between the mind, body, and consciousness as described in Indian philosophical systems such as Vedanta, Samkhya, and Yoga. The research will explore the practical applications of Indian mental health traditions through the lens of Ayurveda, the ancient Indian system of medicine. Ayurveda offers a holistic approach to mental well-being, emphasizing the balance of doshas (bioenergetic principles) and the adoption of lifestyle practices, dietary guidelines, and herbal remedies. By synthesizing the information from these diverse texts, this study aims to create a comprehensive framework for understanding Indian mental health from an indigenous perspective. It will provide valuable insights into the historical and cultural context of mental health practices in India, contributing to the broader field of cross-cultural psychiatry and psychology. The findings of this research hold potential implications for contemporary mental health care, highlighting the significance of integrating traditional Indian knowledge systems with modern approaches. The study seeks to foster a deeper appreciation and recognition of Indian mental health practices and their relevance in the present-day

context. The findings will contribute to a broader understanding of mental health and inform contemporary approaches to holistic well-being.

Keywords: Mental health, Well-being, Indian knowledge tradition Vedas, Upanishads, Yoga sutras.

Exploring the Relationship between Superluminal Particles and Thought Process

Vivek Kumar Srivastava¹ ^, Alok Kumar Verma¹, Garima Vaish²

¹ Department of Physics, Prof. Rajendra Singh (Rajju Bhaiya) Institute of Physical Sciences for Study and Research, Veer Bahadur Singh Purvanchal University, Jaunpur-222003, India

² Department of Physics, University of Allahabad, Prayagraj-211002, India

Abstract:

Faster than light particles revealed notable advancements in interdisciplinary fields which has yielded valuable insights into the theoretical and experimental aspects, despite the current unavailability of its direct detections in physical laboratory settings [1, 4, 5, 10–12, 14, 15, 18, 19]. These advancements have implications for mind-brain physics, prompting further exploration of the relationship between superluminal phenomena and the nature of consciousness. It explains the phenomenon involved in the occurrence of an event from the consciousness of our mind in physical reality [6–9]. Causality principle explains existence of superluminal particles [2, 3, 13, 17] and, furthermore, relates to the thought process of our brain. The proposed explanation of causality in subluminal and superluminal frames explicitly removes the discrepancy of violation of causality, employing the established framework [16]. By exploring the explicit relationship between superluminal particles and the thought process of the brain, a comprehensive understanding of causality is developed. This proposes the existence of mind waves, which correspond to individual cause and effect relationships between the superluminal and subluminal frame of reference. The concept of superposition of superluminal waves is introduced, highlighting its relevance to the thought process of the brain, which expounded the happening of an event in the realm of subluminal frame. The phenomenon underlying event occurrence and its relationship with consciousness also has been explored. By considering the concept of mind waves and their superluminal nature, the study sheds light on the connection between consciousness and the manifestation of events in physical reality.

Keywords: causality, mind-brain, consciousness, superluminal

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Workshop

Workshop - 1: Theravada Buddhist Vipassana

Shailaja D Sharma

A brief outline of the workshop:

A brief outline of the workshop: This proposal is based on a simple experience of Theravada Buddhist Vipassana rather than on a detailed knowledge of MBC theories. The proposal is to read the relevant Pali/ Sanskrit verses pertaining to the phenomenon of paticcasamuppada (which is translated as “Dependent Arising”) and associated commentary from a few sources. The participants will be given a brief introduction into the topic and the reading will be open-ended. The purpose of the workshop is to promote a discussion on the possible (scientific) interpretations of the paticcasamuppada in the language of modern science.

Duration (number of hours): 4-6 hours

No of desired/expected participants (in case of any restrictions): 10

Planned activity in the workshop (talks, demos, activities etc.): Introductory talk, followed by reading of original text and commentaries; discussions and summary.

Any other information and special requirements: Nil

Workshop - 2: One day Workshop on Indian Culture and Educational Knowledge systems

Prof. P. Hari Krishna

A brief outline of the workshop:

In this workshop, two basic aspects like Indian culture and Educational Knowledge systems will be dealt through 2 talks (Powerpoint presentations with the help of photos and videos for easy understanding) of around 90 minutes duration covering the following.

In Indian Culture (3 subtopics @ 30 min each)

1. Body – mind – soul wellness
2. Meditation for cleansing Mind, Peace and Joy
3. Healthy Habits & Hobbies

In Educational Knowledge Systems (3 sub topics @ 30 min each)

1. Personality Development & Character build-up
2. Principle centered Leadership
3. Balancing Ambition & Inner fulfilment

In addition, some value-based dramas (if some students / volunteers / participants cooperate) will be planned along with some group discussions on Indian culture.

Preferably not more than 100.

Planned activity in the workshop (talks, demos, activities etc.):

2 talks, 2 dramas (if participants cooperate and participate) and group discussions.

Any other information and special requirements:

Dr. P. Hari Krishna is working as Professor in the department of civil engineering at of NIT Warangal. He is the pioneering faculty who has established the Center for Value Education along with one of the senior professors Late TKV Iyyengar from the Department of Mathematics. He served as the faulty in-charge for this Center for Value Education for 3 times (each time for 2 years duration – totally for about 6 years period). During his tenure, this club received BEST CLUB prize for its Innovative and enlightening extracurricular activities. As a faculty advisor of this club, he published some technical papers in journals along with a book entitled “Value Education for Young Leaders” published by Partridge, India with 10 topics which were finalized based on a survey conducted at our institute itself. He has bagged some awards in the national level for his contribution to the area of Value Education.

Workshop - 3: Cognitive Wellness and Indian Traditional Healthcare

Ashwini Godbole

The University of Transdisciplinary Health Science and Technology

A brief outline of the workshop:

Cognitive health has a major influence on the quality of life of an individual. Many factors including age, stress and life style affect cognition. Scientific research in the field has provided deep insights in details of the structural and functional changes/alteration happening during cognitive decline. However, unfortunately, very few solutions are available to prevent or manage the deleterious changes. Indian medical systems prescribe many solutions to enhance and maintain cognitive health. In the proposed workshop we will try to bring in experts from diverse disciplines which provide insights and solutions for cognitive health and wellness. The talks, discussions and activities would be focused on transdisciplinary research studies based on the cutting edge research methodologies and sustainable, holistic solutions.

Planned activity in the workshop (talks, demos, activities etc.)

a. 3-4 talks of 30 min each by experts from cognitive neuroscience, neurobiology, brain imaging and different medicines (e.g. Yoga, Ayurveda and modern medicine). b. Panel discussion on possible areas of integration

c. Demo/Activity with internationally assessment tools used for cognition, prakriti etc