8th Annual Conference of Cognitive Science

20 - 22 January 2022

Abstract Book

Organized by

MIND BRAIN CENTER

AMRITA VISHWA VIDYAPEETHAM

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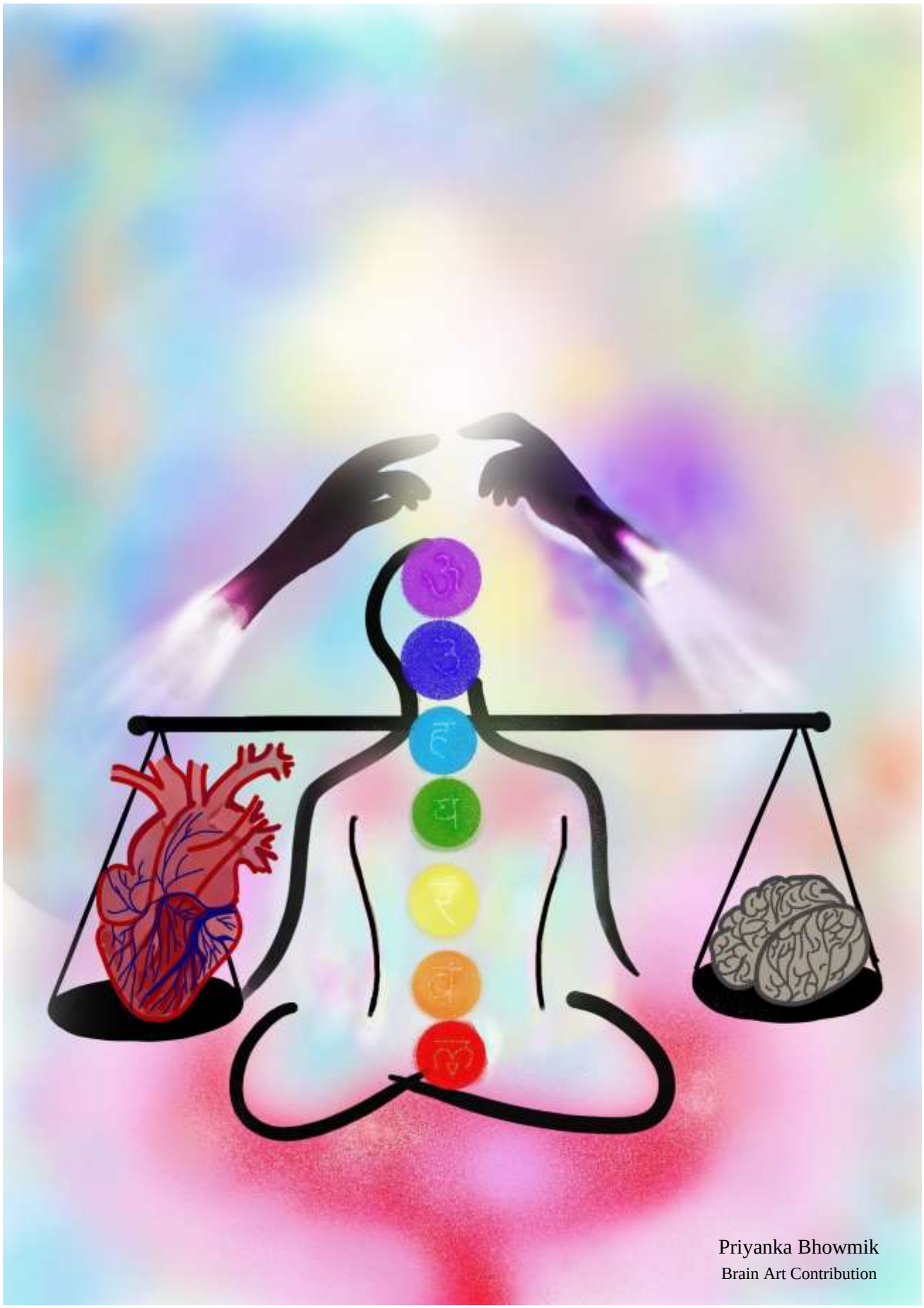


Priyanka Bhowmik
Brain Art Contribution

Table of Content

ACCS8 Poster Presentations

Preface

Proceedings of the 8th Annual Conference of Cognitive Science (ACCS8)

It is our pleasure to welcome you to the 8th Annual Conference on Cognitive Science (ACCS8) held online and organized by the Amrita Mind Brain Center, Amrita Vishwa Vidyapeetham (Amrita University), Kerala India from January 20-22, 2022. Cognitive Science is an interdisciplinary domain that challenges researchers and scientists to examine cognitive processes and understand how the mind works, functions, and behaves. Given the interdisciplinary nature of cognitive science, The Government of India and the Department of Science and Technology had formed the Association for Cognitive Science (ACS) in 2013. In the last seven years, the ACS has been organizing an Annual Conference of Cognitive Science (ACCS) at some of the top universities in India including IIT Kanpur, IIT Gandhinagar, IIT Guwahati, IISc Bangalore, BITS Pilani Goa and University of Hyderabad. In the 2022 event organized by Amrita Vishwa Vidyapeetham, ACCS8 had 700 participants of which several of them were researchers or PhD students. The 30 oral and 61 poster presentations allowed 3 tracks of talks and 3 tracks of poster jam sessions.

2022's ACCS has been graced by a wonderful array of 6 keynote speakers from various regions across the world. Prof. Nandini Chatterjee Singh from UNESCO MGIEP (India) talked on Game-based courses for learning – results of an online digital game-based course to build social and emotional skills in adolescents. Prof. Claudia Gandini Wheeler-Kingshott of University College London (UK) addressed on Principles of quantitative magnetic resonance imaging and relevance to clinical applications. Prof. Kenji Doya of Okinawa Institute of Science and Technology (Japan) spoke on Neural Circuits for Mental Simulation. Prof. Egidio D'Angelo of University Pavia (Italy) addressed Bottom-up and top-down strategies for multiscale brain modelling. Prof. Ned Block of New York University (USA) spoke on an empirical argument that perception is non-conceptual. Prof. Bhavani Rao R of Amrita University (India) addressed on "Humane" Computer Interaction – The role of HCI in facilitating social and vocational empowerment.

The inaugural ceremony on January 20, 2022, had set an opening into this event. Prof. Shyam Diwakar, Director, Amrita Mind Brain Center welcomed participants. Sampujya Swami Amritaswarupananda Puri, President, Board of Trustees, Amrita Vishwa Vidyapeetham delivered the benedictory address. Prof. Bipin Nair, Dean, Life Sciences and School of Biotechnology spoke of Amrita initiatives and University's mission and vision. Prof. Bapi Raju S, Professor, International Institute of Information Technology (IIIT) Hyderabad addressed the gathering as the conference chair. Prof. Dr. Anand Kumar A, Vice Principal, Amrita School of Medicine and HOD, Neurology, Amrita Institute of Medical Sciences addressed the gathering. The conference also included a fireside chat session "NeuroBytes" organized and hosted by Prof. Nithin Nagaraj, National Institute of Advanced Studies, Bengaluru (India) and Prof. Veeky Baths, BITS Pilani Goa campus.

ACCS8 held online was a success against the odds and scenarios imposed by COVID-19 and

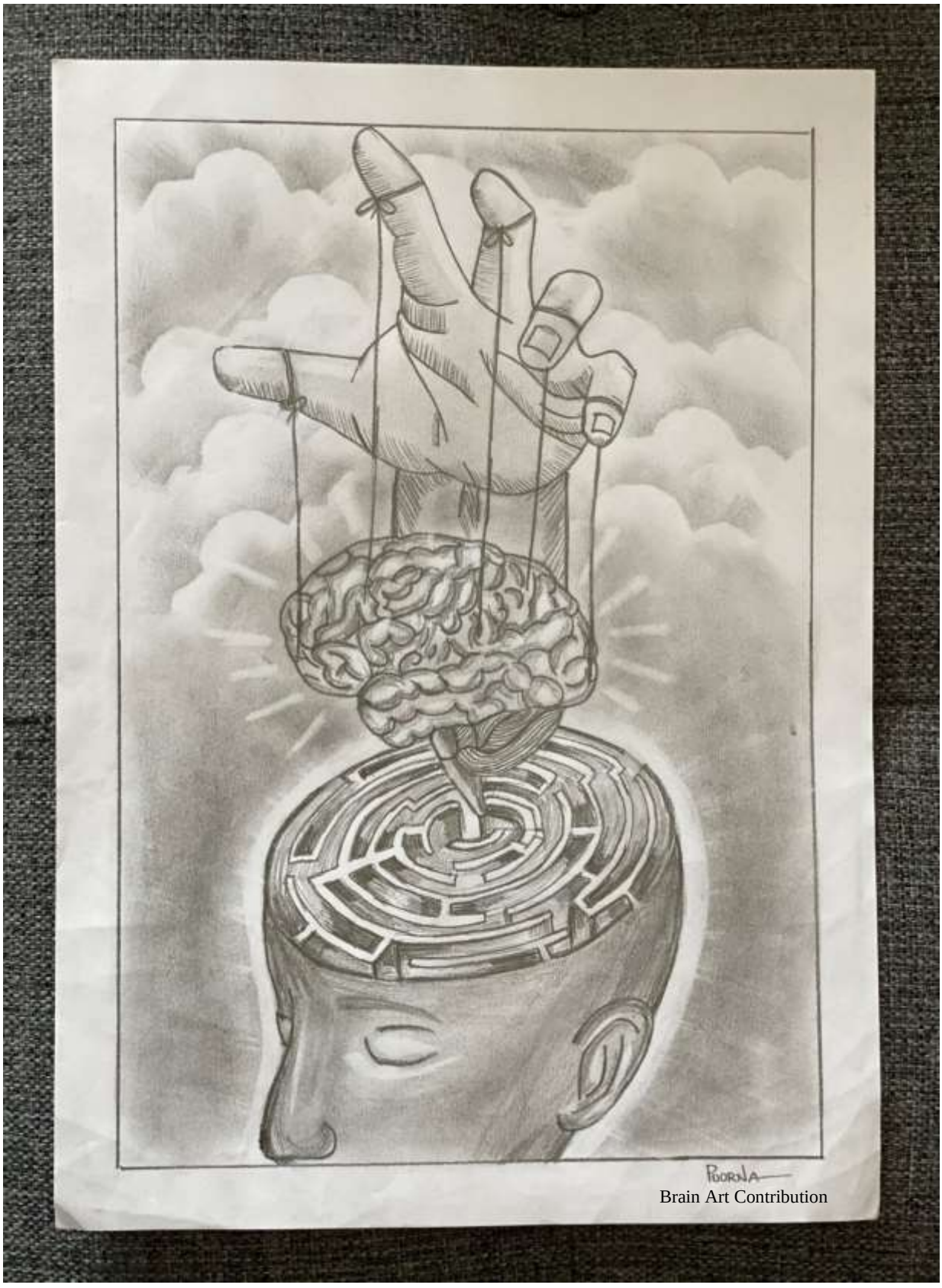
its variants. We are grateful to our colleagues who had helped us review and select the submitted abstracts. We also had an exciting all-ages art competition themed on mind and brain called BRAIN ART, that received over 300 artwork contributions from children from various schools and from others from within India. The 2022 keynote lectures and the presentations by ACCS8 authors bridged the gap between the different fields of cognitive science and related neurosciences, modelling and artificial intelligence topics, making it also possible for non-experts within an area to gain insight into new topics. With the rapidity of advancement of cognitive science, we expect that these future ACCS conferences will be more stimulating as this most recent one was. We thank everyone who joined and helped us with ACCS8.

Shyam Diwakar
Amrita Vishwa Vidyapeetham

Krishna Prasad Miyapuram
IIT Gandhinagar

Narayanan Srinivasan
IIT Kanpur

Bapi Raju S
IIIT Hyderabad



Brain Art Contribution

About ACCS

Cognitive Science is an interdisciplinary domain that challenge researchers and scientists to examine cognitive processes and understand how the mind works, functions, and behaves. The understanding of cognition needs knowledge in different areas including Neuroscience, Artificial Intelligence, Linguistics, Human-Computer Interaction, Skilling, Medicine, Anthropology, Psychology, Philosophy, and Education. Given the interdisciplinary nature of cognitive science, The Government of India and the Department of Science and Technology had formed the Association for Cognitive Science (ACS) in 2013. In the last seven years, the ACS has been organizing an Annual Conference of Cognitive Science (ACCS) at some of the top universities in India including IIT Kanpur, IIT Gandhinagar, IIT Guwahati, IISc Bangalore, BITS Goa and University of Hyderabad. This year the conference will be hosted by Amrita Mind Brain Center (AMBC), Amrita Vishwa Vidyapeetham at Amritapuri Campus in Kerala. In this online conference we had keynotes, paper presentations, poster sessions, panel discussions, Brain Art drawing competitions etc.

About Amrita Vishwa Vidyapeetham

The NAAC accredited A++ graded, multi-campus, multi-disciplinary teaching and research university currently has 7 campuses with 16 constituent schools across Indian states of Tamil Nadu, Kerala, Andhra Pradesh and Karnataka with the headquarters at Ettimadai, Coimbatore, Tamil Nadu. It offers a total of 207 undergraduate, postgraduate, integrated-degree, dual-degree, doctoral programs in Engineering and Technology, Medicine, Business, Arts & Culture, Sciences, Biotechnology, Agricultural Sciences, Allied Health Sciences, Ayurveda, Dentistry, Pharmacy, Nursing, Nano-Sciences, Commerce, Humanities & Social Sciences, Law, Literature, Spiritual studies, Philosophy, Education, Sustainable Development, Mass Communication and Social Work. The university is Ranked 5th best university in India according to National Institutional Ranking Framework (NIRF) 2021 by Government of India and Ranked 81st in the world by Times Higher Education (THE) Impact Rankings in the Year 2021.

About Amrita Mind Brain Center

The Amrita Mind Brain Center has been established by Chancellor Sri. Mata Amritanandamayi Devi (AMMA) to drive scientific advancements combining focused efforts from multiple schools, integrating neurosciences, experimental methods in the study of nervous systems and behavior, building medical devices, further understanding neurological disorders, pave new paths in the science of yoga and meditation, advance artificial intelligence and studying the mind and consciousness. With focus on brain and mind related health and technologies, the center will orchestrate the development and application of new technologies to investigate brain function, dysfunction, and therapy.

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PROGRAM SCHEDULE

Day 1, Thursday, January 20, 2022	
09:00 - 10:15AM	**Inaugural ceremony**
10:15 - 10:30AM	**Tea Break**
10:30 - 11:30 AM	**Keynote Talk 1** **Game-based courses for learning – results of an online digital game-based course to build social and emotional skills in adolescents** *Nandini Chatterjee Singh, UNESCO MGIEP*
11:35 - 12:55PM	**Poster Session 2** 1. **Personality Profiles of 'Troublesome' People** *Apeksha Srivastava and Frederick L. Coolidge* 2. **Introducing a standardize affective picture set based on repetitious everyday life pictures in Iranian media** *Arefe Atamanesh, Abdol-Hossein Vahabie Javad Hatami and Pooya Sajjadi* 3. **Psycho-Social Correlates Of Suicidal Ideation Among College Student** *Anajan Prusty* 4. **Interaction between Enumeration and Perceptual Averaging over different Presentation duration** *Sumit Pareek, Anjana Prusty, Anuj Shukla and Rakesh Sengupta* 5. **Recall Errors For Features In A Single Object Increases With Intervening Recall Probe Question** *Srishti Jain, Raju S. Bapi and Rakesh Sengupta* 6. **The decrease in Vitamin D and changes in white matter integrity leads to cognitive impairment in elderly population from Northern India** *Abhai Kumar and Rameshwar Nath Chaurasia* 7. **Waist circumference and body fat percentage are the potential indicators of cognitive performance among postmenopausal women** *Mankamal Kaur and Maninder Kaur* 8. **Effects of early abstinence on cognitive functions in alcohol-dependent patients** *Amol Kirat Kaur and Dr. Prabhoo Dayal* 9. **The Perception of Abstractness of Concepts** *Vanalata Bulusu* 10. **Effect Prospective Memory Loading On Accuracy Of Prospective Memory And Ongoing Task** *Dasmine D'Souza, Gagan Bajaj and Jayashree Bhat* 11. **'Am I what I believe?' An attempt to explore Metacognitive Accuracy using Absolute Self-Estimations.** *Nidhi Lalu Jacob, Dr. Gagan Bajaj, Aysha Rooha, Dr. Vinitha Mary George and Dr. Jayashree S Bhat* 12. **Turnover Decision Making Under Risk: Evaluating The Mediating Role Of Organizational Justice And Organizational Commitment Among The Security Personnel In Jammu & Kashmir** *Dr. Shakir Hussain Parrey* 13. **'Are my cognitive abilities really as good as others?' - A study to explore metacognitive abilities** *Aysha Rooha, Dr. Gagan Bajaj, Nidhi Lalu Jacob, Dr. Vinitha Mary George and Dr. Jayashree S. Bhat* 14. **Cognitive Behaviour In Teleost**

	Atifa Haseeb Ansari and Sippy Singh 15. **Cultural Adaptation of M-CHAT R/F Malayalam version** *Dr. Nandini Jayachandran, Dr. Immanuel Thomas, Dr. Mary Iype, Dr. Suresh P.A. and Sneha Sebastian1* 16. **Use of Music and Social Media for Social Surrogacy during Covid-19 lockdowns in India** *Saumya Srivastava and Vinoo Alluri* 17. **The roles of trait anxiety, psychological flexibility and coping strategies on the mental health impact of COVID-19 on college students in India** *Adithya Jain, Rishabh Singhal and Priyanka Srivastava* 18. **The Effect of the Type of Music on Human Attention** *Nitya Ann Eapen, Sai Chandana Mukkamala and Madhavi Rangaswamy* 19. **An Exploration of the Effects of Bimodal Stimuli on Selective Attention** *Krithika Nambiar and Pranesh Bhargava* 20. **The Effect of Stress on Abstract Reasoning** *Sanskar Tibrewal, Arathy Rose Tony, Vivek Pamnani and Priyanka Srivastava*
1:00 - 1.30 PM	**Poster Q &A sessions** (individual parallel Zoom sessions)
1:30 - 2:45 PM	**Lunch Break**
	Keynote Talk 2 **Principles of quantitative magnetic resonance imaging and relevance to clinical applications** *Claudia Wheeler-Kingshott, University College London, UK*
4:00 - 4:30 PM	**Tea Break**
4:30 - 6:45 PM	**Talk Session 1** 1. **Positive, not negative, emotions facilitate response inhibition under high load** *Shubham Pandey and Rashmi Gupta* 2. **Cross Cultural Evaluation of Emotional Words on an Indian Population** *Himansh Sheoran and Priyanka Srivastava* 3. **Reversibility and Rationality in Jean Piaget's Theory of Reasoning** *Mark Winstanley* 4. **Numerosity based Go/No-go task Performance influenced by Subitizing and Estimation range but not Relative Numerosity** *Srishti Jain, P. V. Raja Shekar and Rakesh Sengupta* 5. **How do bad memories and ability to judge Morality affect deceptive Behaviour?** *P Venkata Ramana Rao, B Micheal Jackson, Rakesh Sengupta and P V Raja Shekar* 6. **Trait mindfulness is associated with shorter temporal horizons, but not lower delay discounting** *Shivam Bohra and Narayanan Srinivasan* 7. **Multiple Object Awareness capacity is larger and correlates with Visual Working Memory capacity** *Prasad Mane and Narayanan Srinivasan* 8. **Intra-individual Variability in Reaction Time: A Marker of Sex Differences in Prefrontal Cortex (PFC) Cognitive Control Tasks** *B Indupriya and Singh Varsha* 9. **Musical aptitude - a better indicator of reaction time than musical training** *Azhagammal Sc, Elvira Brattico and Vinoo Alluri* 10. **Contingency of the Capture: Conscious and Unconscious?** *Shivam Puri, Seema Prasad and Ramesh Mishra*
Day 2, Friday, January 21, 2022	
09:00 - 11:15AM	**Talk Session 2** 1. **Electrical vestibular nerve stimulation: An alternative therapy to improve spatial and verbal memory in patients with Parkinson's disease** *Dr Sai Sailesh Kumar Goothy, Dr Sudhir Gawarikar, Dr Anita Choudhary, Dr Potey G G, Dr Manju Purohit, Ashish Pathak, Rohit Singh Chouhan and Mahadik V K*

	2. **The graded rise of inflammatory markers in hippocampus induced by streptozotocin (STZ) injection at increasing time points showed correlations with some memory impairments in rats** *Nicky Singh, Debasish Bandopadhyay and Tusharkanti Ghosh* 3. **A scale-invariant perturbative approach to study information communication in dynamic brain networks** *Varun Madan Mohan and Arpan Banerjee* 4. **Aperiodic and periodic components of ongoing oscillatory brain dynamics link distinct functional aspects of cognition across adult lifespan** *Kusum Thuwal, Arpan Banerjee and Dipanjan Roy* 5. **Neurocognitive dysfunction in patients with opioid dependence: Does it improve on buprenorphine-based agonist treatment?** *Abhishek Ghosh, Simranjit Kaur, Abhishek Verma, Debashish Basu, Ritu Nehra, Chirag K Ahuja, Paramjit Singh and Manish Modi* 6. **Measuring the Level of Consciousness in the Brain using Network Connectivity Approaches** *Aditi Kathpalia and Nithin Nagaraj* 7. **Decoding hand grasped movement with EEG: Characterizing gamma oscillations, temporal biomarkers and other cortical potentials.** *Bodda Sandeep and Shyam Diwakar* 8. **Direct vs Indirect injury response to neonatal brain: a study of white matter volume, Cognition and resting state network changes in Birth brachial plexus vs Traumatic brachial plexus injury.** *Shubham Kaushal, Dhananjaya I. Bhat, Dhaval P. Shukla and B.Indira Devi* 9. **Distinct roles of MMN and P300 in processing prediction errors across modalities** *Priyanka Ghosh, Siddharth Talwar and Arpan Banerjee* 10. **Neural Correlates of Understanding Object Concept in Human Brain** *Shefali Gupta and Tapan Gandhi*
11:15 - 11:25AM	**Tea Break**
11:25 - 11:45AM	**Sponsors Presentation** **Tobii Pro Eye tracking as tool in Research** *Parag Amodkar, Tobii Pro AB*
12:00 - 1:00 PM	**Keynote Talk 3** **Neural Circuits for Mental Simulation** *Kenji Doya, Okinawa Institute of Science and Technology, Japan*
1:00 - 2:00 PM	**Lunch Break**
2:00 - 2:45PM	**Poster Session 2** 1. **Modulatory Effects of Hand Presence on Temporal Judgments** *Krishnapriya Ks and Tony Thomas* 2. **Effect of hydroalcoholic extract of Centella asiatica on 3-nitropropionic acid induced Huntington like symptoms in adult zebrafish** *Vishal Kumar and Arti Singh* 3. **Cross-cultural evaluation of erotic and gory images of International Affective Picture System on an Indian sample** *Surabhi Lodha and Rashmi Gupta* 4. **Neurocognition and COVID-19: The Identification of Neurocognitive Patterns in Patients with and without Anosmia** *Madhumita Mahali and Frederick L. Coolidge* 5. **Quercetin Alleviated Rotenone-induced Neuroinflammation, Memory, and Cognitive Alteration in Swiss Albino Mice** *Dr. Juli Jain, Dr. Whidul Hasan, Mr. Pronit Biswas, Dr.Rahesh Singh Yadav and Dr. Deepali Jat* 6. **Impairments in navigational search strategy switching during early stages of disease pathogenesis in a mouse model of Alzheimer's disease** *Smitha Karunakaran* 7. **Effect of multi-talker noise at different SNRs on listening effort among individuals with noise induced hearing loss**

	Hemanth Shetty 8. **A Review On Icariin: A Promising Perspective For Future Application In Parkinson's Diseases** *Jyoti Raghav and Nandini Dubey* 9. **Development in a Homosexual's Experiences: Childhood Encounters of Gay Individuals** *Pratosh Kamal Das and Baiju Gopal* 10. **Development of Cognitive retraining module for improving cognitive deficits of abstinent patients with Alcohol Dependence Syndrome, Cannabis Dependence Syndrome and Opioid Dependence Syndrome in a Tertiary Care De-addiction Centre of Northern India** *Gaurishanker Kaloiya, Siddharth Sarkar, Piyush Ranjan,Ashwani Mishra, Tanveer Kaur and Abhishek Banga*
3:00 - 4:00 PM	**Keynote Talk 4** **Bottom-up and top-down strategies for multiscale brain modelling** *Egidio D'Angelo, University of Pavia, Italy*
4:00 - 4:30 PM	**Tea Break**
4:30 - 5:15PM	**Poster Session 2** 1. **Visuo-locomotive Update in Naturalistic Navigation: Multimodal analysis examining the role of familiarity and rotational locomotion** *Vasiliki Kondyli and Mehul Bhatt* 2. **Cognitive achievement in offspring of diabetic mothers** *Rishikesh Behere, Sonali Wagle, Naomi Dsouza, Rohan Shah, Swapnali Sonawane, Aboli Bhalerao and Chittaranjan Yajnik* 3. **Multimodal Screening For Dyslexia** *Harismithaa Lr and Dr. G. Sudha Sadasivam* 4. **Neurodevelopmental genes in photoparoxysmal EEG response** *Swetha Damodharan, Mary Iype and Ayyappan Anitha* 5. **Mechanism of mood stabilizing drug's action to explore new avenue for drug target** *Shruthy Priya P, Bhuvarahamurthy Venugopal and Parthasarathy Ranga N* 6. **Efficacy of Cognitive Retraining among patients with SUDs having Cognitive Deficits: A Narrative Review** *Gaurishanker Kaloiya, Abhishek Banga, Piyush Ranjan, Ashwani Mishra, Prabhu Dayal and Siddharth Sarkar* 7. **Examining the effect of SNPs of circadian clock components in stroke induced cognitive Impairment** *Dr.Dipanwita Sadhukhan, Dr. Arindam Biswas and Dr. Atanu Biswas* 8. **One Carbon Metabolism in Health and Disease: Special Emphasis on Cognition** *Prof. Kallur Nava Saraswathy* 9. **Dynamic allocation of cognitive resources under risk** *Samarth Mehrotra and Nisheeth Srivastava* 10. **Investigation of Cognitive function and Brain Energy Metabolism in Mouse Model of Alzheimer's disease** *Anant Bahadur Patel*
5:30 - 6.00 PM	**Poster Q &A sessions** (individual parallel Zoom sessions)
6:15 - 7:15PM	**Cultural Program**

Day 3, Saturday, January 22 2022

7:30 - 8:30 AM	**Keynote Talk 5** **An empirical argument that perception is non-conceptual** *Ned Block, New York University, USA*
8:30 – 9:00AM	**Breakfast**
09:00 - 11:45AM	**Talk Session 3** 1. **Consciousness is an invention, neither a hard neither an easy problem, never an illusion. Consciousness it's not the explanandum, consciousness is the explanans.** *Vitor Manuel Dinis Pereira*

	2. **Does Case Marking influence the Timing of Verb Retrieval during Sentence Production?** *Mudafia Zafar and Samar Husain* 3. **On-center off-surround RNN model for enumeration in natural images using saliency maps** *Bhavesh K Verma, Raju S. Bapi,Ravichander Janapati and Rakesh Sengupta* 4. **Mathematical Modelling of Biochemical Networks in Neurodegenerative Diseases** *Hemalatha S and Shyam Diwakar* 5. **Resting-state functional MRI connectivity alterations related to cognitive changes in intracranial dural arteriovenous fistulas before and after embolization treatment** *Sabarish Sekar, Santhosh Kumar, Kannath, Sushama Ramachandran, Ramshekhar N. Menon and Bejoy Thomas* 6. **Modeling joint torque estimations for a lower and upper limb based on accelerometer derived gait data for assistive exoskeleton** *Abhijith Balachandran, Chaitanya, Nutakki and Shyam Diwakar* 7. **Locality Effects in the Processing of Argument Structure and Information Status using Reading Aloud Paradigm** *Rupesh Pandey, Sidharth Ranjan and Rajakrishnan Rajkumar* 8. **The impact of the second wave of COVID-19 on Indian students and the mediating roles of psychological flexibility and coping strategies** *Adithya Jain, Rishabh Singhal and Priyanka Srivastava* 9. **Procrastination and Progress-Effort Characteristic of a Task** *Pritam Laskar and Nisheeth Srivastava* **8. Evaluating the ML Models for MindBigData (IMAGENET) of the Brain Signals** *Priyanka Jain, Mayuresh Panchpor, Saumya Kushwaha and Naveen Kumar Jain*
12:00 - 1:00 PM	**Keynote Talk 6** **"Humane" Computer Interaction - The role of HCI in facilitating social and vocational empowerment** *Bhavani Rao, Amrita Vishwa Vidyapeetham*
1:00 - 2:00 PM	**Lunch Break**
2:00 - 3:20 PM	**Poster Session 3** 1. **The Role of BMI and Perceptual Load in Attention Capture by Food Stimuli** *Rajeshwari Muthukumaran, Rashmi, Gupta, Naomi Kakoschke and Antonio Verdejo-García* 2. **The benefit of knowledge generation using hands** *Seokmin Kang and Mingtsan Lu* 3. **Occasion Noise is moderated by Expertise: Insights from over a Billion open-source chess games** *Amarnath Dasaka, Bapi Raju Surampudi and Praneeth Gosu* 4. **Visual Memory Enhancements Near the Hands** *Lakshmi P and Tony Thomas* 5. **Emo-Spots: Detection and Analysis of Emotional Attributes through Bio-Inspired Facial Landmarks** *Bakkialakshmi. V.S* 6. **A Study On Parkinson's Disease Under The Context Of Reinforcement Learning** *Sreeja Sasidharan Rajeswari and Dr.Manjusha Nair* 7. **Deep Learning Framework for Causal Connectivity based Epileptic Neuromarkers from Multi-channel EEG** *Vishwambhar Pathak, Prabhat K Upadhyay and Vivek Gaur* 8. **Cerebellum Model Circuitry Explaining Knockout Behaviour of Purkinje Neuron during Movement Disorder** *Arathi Rajendran and Shyam Diwakar* 9. **Stability of sensorimotor network sculpts the dynamic repertoire of resting state across age** *Nisha Chetana Sastry, Dipanjan Roy and Arpan Banerjee*

	10. **Modelling neural activity dependent vascular changes in cerebellar granular layer** *Sreedev R, Chaitanya Nutakki and Shyam Diwakar* 11. **Computational Modeling of Neurovascular Coupling and fMRI BOLD Correlates of Neural Circuits using BOLDsim** *Chaitanya Nutakki and Shyam Diwakar* 12. **Implementing Web-based Bioinformatics and Biosignal Analysis Virtual Laboratories for Neuroscience Education in Universities** *Dhanush Kumar, Joshy Alphonse, Krishnashree Achuthan, Bipin Nair and Shyam Diwakar* 13. **Learner Perception and Preferences of Using Virtual Laboratories in STEM education pre and post-COVID -19 Pandemic** *Rakhi Radhamani, Anandhu Presannan, Krishnashree Achuthan, Bipin Nair and Shyam Diwakar* 14. **Computational Drug Repurposing Approach To Identify Potential Dpp-4 Inhibitors To Develop Novel Antiparkinson Therapy** *Parag Varshney and Girdhar Khandelwal* 15. **Cognitive Neuroscience of Behavioural Addiction: Exploring the Role of Reward and Compulsivity Circuits** *Jaisoorya Ts* 16. **Temporal structure of heart-brain interactions across adult lifespan** *Kirti Saluja, Dipanjan Roy and Arpan Banerjee* 17. **Multimodal and Interpretable Diagnostic-cum-Therapeutic Framework for Epileptic Seizure Prediction** *Rajat Gupta, Aniket Joshi, Shaurya Shriyam and Tapan Gandhi* 18. **Music Emotion Recognition via Deep Learning and comparison with human perception** *Ramaguru Guru Ravi Shanker and Vinoo Alluri* 19. **What catches the eye? Priming, bottom-up processing and visual letter search** *Kathryn Sam, Pranjali Ektare and Madhavi Rangaswamy* 20. **Design Synthesis & Analysis Training – Impact on Innovation Abilities in Engineering Students** *Vidisha Golecha, P.V. Raja Shekhar and Sridhar Condoor* 21. **Effect of Nature Experience on Fronto- Parietal Correlates of Neurocognitive Processes: An ERP Study** *Dr. Pooja Sahni and Prof. Jyoti Kumar*
3:20 - 3.50 PM	**Poster Q &A sessions** (individual parallel Zoom sessions)
4:00 - 5:00 PM	**Fireside chat** **NeuroBytes** *Hosted by:* *Nithin Nagaraj, NIAS, Bengaluru* *Veeky Baths, BITS Pilani, Goa Campus*
5:00 - 5:30 PM	**Tea Break**
5:30 - 6:00 PM	**Valedictory Function**
6:15 - 7:15 PM	**General Body Meeting**

Brain Art Contribution

INVITED KEYNOTE LECTURES

Game-based courses for learning – results of an online digital game-based course to build social and emotional skills in adolescents.

Nandini Chatterjee Singh,
Senior National Program Officer
UNESCO MGIEP, New Delhi – 110 001
n.chatterjee@unesco.org

It is estimated that one in three individuals worldwide plays digital games. Play has been demonstrated to be an evolutionary feature that enables mammals to acquire new knowledge by exploration and experimentation. Why then are games not part of pedagogy and are disconnected from learning?

In this presentation, I will discuss how the power of storytelling offered by digital games can be harnessed to build social and emotional learning (SEL) in the classroom. Social and emotional skills are being increasingly being recognized as fundamental competencies necessary to build in children to ensure holistic development and build successful relationships. We used a narrative-driven text messaging adventure commercial game entitled Bury me, my love, and designed an online interactive course around it. The game centres around Nour, a Syrian refugee who undertakes a perilous journey to safety in Europe. The game-based course uses the life of a refugee, to introduce learners to concepts of migration, home, belonging and identity and also build social emotional skills like empathy, compassion and resilience.

To assess the impact of the game-based course, a research study was conducted with 201 participants between 13 and 16 years of age across United Arab Emirates and India. Knowledge on the theme of migration, and social and emotional skills of empathy and compassion were assessed through self-reports completed by participants before and after taking the course. Independent T-test analysis revealed significant cultural and gender differences in domains of compassion and empathy respectively. This study opens a new window in game-based learning. The design of a structured course with learning outcomes centered around a digital game establishes its potential to create engaging and accessible solutions to simultaneously build domain knowledge and social-emotional competencies in adolescents.

Nandini Chatterjee Singh is a cognitive neuroscientist and currently Senior Project Office at UNESCO MGIEP (Mahatma Gandhi Institute of Education for Peace and Sustainable Development, in New Delhi, India. Nandini works on learning, in the context of literacy, emotion and music. After receiving a PhD in physics from the University of Pune in India, she studied auditory learning mechanisms in songbirds at University of California Berkeley. She returned to India 2002 and the first cognitive and neuroimaging laboratory in India at the National Brain Research Centre (NBRC) in India. Where she set up SALLY (Speech and Language Laboratory). Using behavioral and functional neuroimaging experiments, her laboratory sought to understand neurodiversity especially children with autism and dyslexia. Her work in biliteracy led to the development of DALI (Dyslexia Assessment for Languages of India), the first tool standardized tool to screen and assess dyslexia in multiple Indian languages. Her research laboratory at NBRC also conducted research on how Indian ragas elicit distinct emotions.Since 2017, she has been at UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP) where she uses neuroscience to design courses for social and emotional learning using digital pedagogies. She has led the development EMC2, a neuroscience-based framework that builds SEL competencies of Empathy(E), Mindfulness (M), Compassion (C) and Critical Inquiry (C). She is focused on designing new interactive curricula using innovative digital pedagogies like, digital games, digital dialogue to cultivate SEL and conducts cross-cultural research to assess their efficacy in school education systems.

Principles of quantitative magnetic resonance imaging and relevance to clinical applications

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In this lecture I will present how Magnetic Resonance Imaging (MRI) can be used for assessing health and disease of brain tissue by measuring properties of the brain in a magnetic field.
The learning objectives of the lecture will be to 1) understand why MRI is clinically important and what makes MRI so powerful compared to other imaging techniques; 2) understand what do we mean by quantitative MRI and biophysically meaningful feature extraction from MRI scans; 3) to assess how we can use MRI for brain microstructure, function and physiology properties assessment; 4) to evaluate challenges to clinical translation and generatability and finally 5) to discuss new frontiers and limits of MRI.
In particular, I will explain how we can use sensitivity to water diffusion in tissue can help us assessing tissue microstructure integrity and properties. Exploiting the sensitivity of MRI to changes in magnetic susceptibility associated to blood oxygenation status during brain function, we can detect areas of functional activations and resting state networks. As example of using MRI to assess physiological properties of brain tissue I will present sodium imaging and sodium ion concentration quantification. This is really far from clinical adoption but could have great impact if technical challenges are met.
Examples of clinical applications will be presented to make the lecture more practical, including in multiple sclerosis (*Toschi et al, Neuroscience, 2019*), neurodegeneration (*Castellazzi et al, Frontiers in Neuroscience, 2014*) and stroke (*Särkämö et al. Frontiers in Human Neuroscience 2014*).
Discussion of emerging areas of development go from the use of high field human scanners (e.g. 7T), to going beyond what we already know and find ways to challenge our approach to study design, to multi-modal applications for example to understand brain dynamics and obviously to big data analysis using artificial intelligence approaches.

Claudia AM Gandini Wheeler-Kingshott is professor of magnetic resonance physics at the University College London Institute of Neurology (UCL IoN, London, UK) and has gained international recognition for her ground-breaking research on translational MRI to study microstructural and functional properties of the central nervous system (CNS). She has developed highly-innovative brain and spinal cord imaging techniques, published in seminal research articles placing her in a leading position world-wide as a prominent MR physicist in neurology. Graduated in Solid State Physics at the University of Pavia in 1994, she moved to the UK where she achieved her PhD in MR Physics at the University of Surrey. In 1999 she joined the NMR Research Unit, Queen Square Multiple Sclerosis Centre at the UCL IoN where she based her academic career. Here, she soon developed the ZOOM technique for diffusion imaging of the spinal cord, now recognised as a key step change in spinal cord imaging. Learning to balance well family and working life, she strived to establish her track record, developing national and international collaborations always with the aim of promoting quantitative imaging biomarkers of the CNS and their translation to the clinics. In this context, Claudia's group works on implementing multi-modal imaging to understand mechanisms of normal and pathological brain and spinal cord, including microstructural techniques, functional MRI, spectroscopy and sodium imaging. Recent work sees Claudia involved in promoting also cross-fertilisation between fields and across scales because she believes that MRI cannot unleash its true potential unless we cross bridges towards other biophysical disciplines.

Neural Circuits for Mental Simulation

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The basic process of decision making can be captured by learning of action values according to the theory of reinforcement learning. In our daily life, however, we rarely rely on pure trial-and-error and utilize any prior knowledge about the world to imagine what situation will happen before taking an action. How such "mental simulation" is realized in the circuit of the brain is an exciting new topic of neuroscience. Here I report our works with functional MRI in humans and two-photon imaging in mice to clarify how action-dependent state transition models are learned and utilized in the brain.

Kenji Doya is a Professor of Neural Computation Unit, Okinawa Institute of Science and Technology (OIST) Graduate University. He took his PhD in 1991 at the University of Tokyo and worked as a postdoc at U. C. San Diego and the Salk Institute. In 1994, he joined Advanced Telecommunications Research International (ATR) as a Senior Researcher and then served as a Group Leader of Kawato Dynamic Brain Project. In 2004, he was appointed as a Principal Investigator of the OIST Initial Research Project and started Okinawa Computational Neuroscience Course (OCNC) as the chief organizer. As OIST established itself as a Graduate University in 2011, he became a professor and served as the Vice Provost for Research. He is interested in reinforcement learning in both natural and artificial creatures. He has served as a Co-Editor in Chief of Neural Networks from 2008 to 2021 and a board member of International Neural Network Society (INNS), Japanese Neural Network Society (JNNS) and Japan Neuroscience Society (JNSS). He serves as the Chairperson of Neuro2022 conference in Okinawa. He received INNS Donald O. Hebb Award in 2018, JNNS Academic Award, APNNS Outstanding Achievement Award, and the age-group 2nd place at Ironman Taiwan in 2019.

Bottom-up and top-down strategies for multiscale brain modeling

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Neuroscience is experiencing a rapid progress of brain modeling promising breakthroughs in ICT, AI and medicine. However, addressing the multiscale brain organization, which is believed to be fundamental for the brain's dynamic repertoire, remains challenging. On one hand, detailed models of neurons and synapses can be connected into large neuronal assemblies, helping to explain the relationship between network activities and microscopic phenomena. The main issue here is that these simulations rapidly increase in complexity and computational cost when large networks are simulated. On the other hand, whole-brain models can be constructed to infer neuronal functions from ensemble measurements like those obtained with MRI or EEG. The major limit in this case is that single neurons and synapses are usually not accounted for. In this talk, I will explain how the bottom-up models (generated from the principles of neuronal biophysics) and the top-down models (based on network and ensemble representations of brain activity) can be developed and simulated. Moreover, I will show how detailed models of brain circuits can be embedded into robotic controllers, neuromorphic hardware, and virtual brains, showing how the synergy of top-down and bottom-up strategies can be combined to effectively generate multi-scale brain models and investigate brain physiology and pathology.

Egidio D'Angelo is Full Professor of Physiology, co-chair of the Department of Brain and Behavioral Sciences and director of the Brain Connectivity Center of IRCCS Mondino. ED coordinates brain research at the international level, spanning from neurophysiology to neurotechnology and medicine, and has uninterruptedly coordinated 9 European projects and several National projects of the Italian Ministry of Health, of the Ministry of the University and Research and other institutions over the 1995-2022 period. In the last 10 years, ED has participated as core partner and co-director in the European Flagship Human Brain Project (HBP- 2020 Framework Programme for Research and Innovation under the Framework Partnership Agreement No. 650003), aimed at bridging cellular-molecular research with integrative neuroscience through computational models and advanced ICT technologies. This HBP activity involves world-wide collaborations on neuronal and microcircuit modeling, MRI and BOLD signals, closed-loop robotic simulators, cellular recordings in vivo, neuronal modelling, Virtual Brain Modeling, Medical Informatics. ED is core partner of CEN (Cerebellum and Emotional Networks), a Marie Skłodowska-Curie ITN that will explore the brain circuits that underlie emotional behavior (Horizon 2020 research and innovation programme- GA No 956414). ED published 194 peer reviewed papers (most as first or last author) including Nature, Science, Nature Neuroscience, Nature Communication, Nature Communications Biology, Cell, Neuron, TINS, J Neuroscience and presented his research at several meetings worldwide, often as invited speaker (recently UCL, CERN, Rimini, TEDex, CAETS). The main scientific interests are centered on the celular and circuit functions of the cerebellum and its pathologies in the context of the whole-brain activity. Additional information can be found at https://dangelo.unipv.it/..

An empirical argument that perception is non-conceptual

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The view that perception is non-conceptual has been advocated on armchair grounds, but I will present actual experimental evidence for it. I will review evidence that infants between the ages of 6 and 11 months can see colors but normally cannot notice them and so normally cannot accomplish even the simplest kinds of cognition involving colors. By contrast, children of the same ages can see shapes and also exhibit rudimentary cognition using shape concepts. I will argue that the upshot is that the color perception of these infants is non-conceptual. I will also present evidence that adults do not have conceptual perception of colors and then explore the extrapolation of these findings to all of perception

Ned Block (Ph.D., Harvard), Silver Professor of Philosophy, Psychology and Neural Science, came to NYU in 1996 from MIT where he was Chair of the Philosophy Program. He works in philosophy of perception and foundations of neuroscience and cognitive science and is currently writing a book on the perception/cognition border, The Border between Seeing and Thinking.He is a Fellow of the American Academy of Arts and Sciences; a Fellow of the Cognitive Science Society; has been a Guggenheim Fellow; a Senior Fellow of the Center for the Study of Language and Information; a Sloan Foundation Fellow at the University of California, Berkeley; a faculty member at two National Endowment for the Humanities Summer Institutes and two Summer Seminars; the recipient of fellowships from the National Endowment for the Humanities, the American Council of Learned Societies, and the National Science Foundation; a recipient of the Robert A. Muh Alumni Award in Humanities and Social Science from MIT; the Jean Nicod Prize (list of past recipients of the Jean Nicod Prize), Ecole Normale Superieure, Paris; and the 2021 Dr. Martin R. Lebowitz and Eve Lewellis Lebowitz Prize for Philosophical Achievement and Contribution jointly with Ian Phillips. The Philosophers' Annual selected his papers as one of the "ten best" in 1983, 1990, 1995, 2002 and 2010. He is a past president of the Society for Philosophy and Psychology, a past Chair of the MIT Press Cognitive Science Board, and past President of the Association for the Scientific Study of Consciousness. He is co-editor of The Nature of Consciousness: Philosophical Debates (MIT Press, 1997). The first of two volumes of his collected papers, Functionalism, Consciousness and Representation, MIT Press came out in 2007. Blockheads! Essays on Ned Block's Philosophy of Mind and Consciousness, edited by Adam Pautz and Daniel Stoljar came out in January, 2019 from MIT Press. It contains 18 articles each of which is review replied to by Ned Block. Ian Phillips' of Blockheads, in Mind, 2020

"Humane" Computer Interaction Technology - The role of HCI in facilitating social and vocational empowerment

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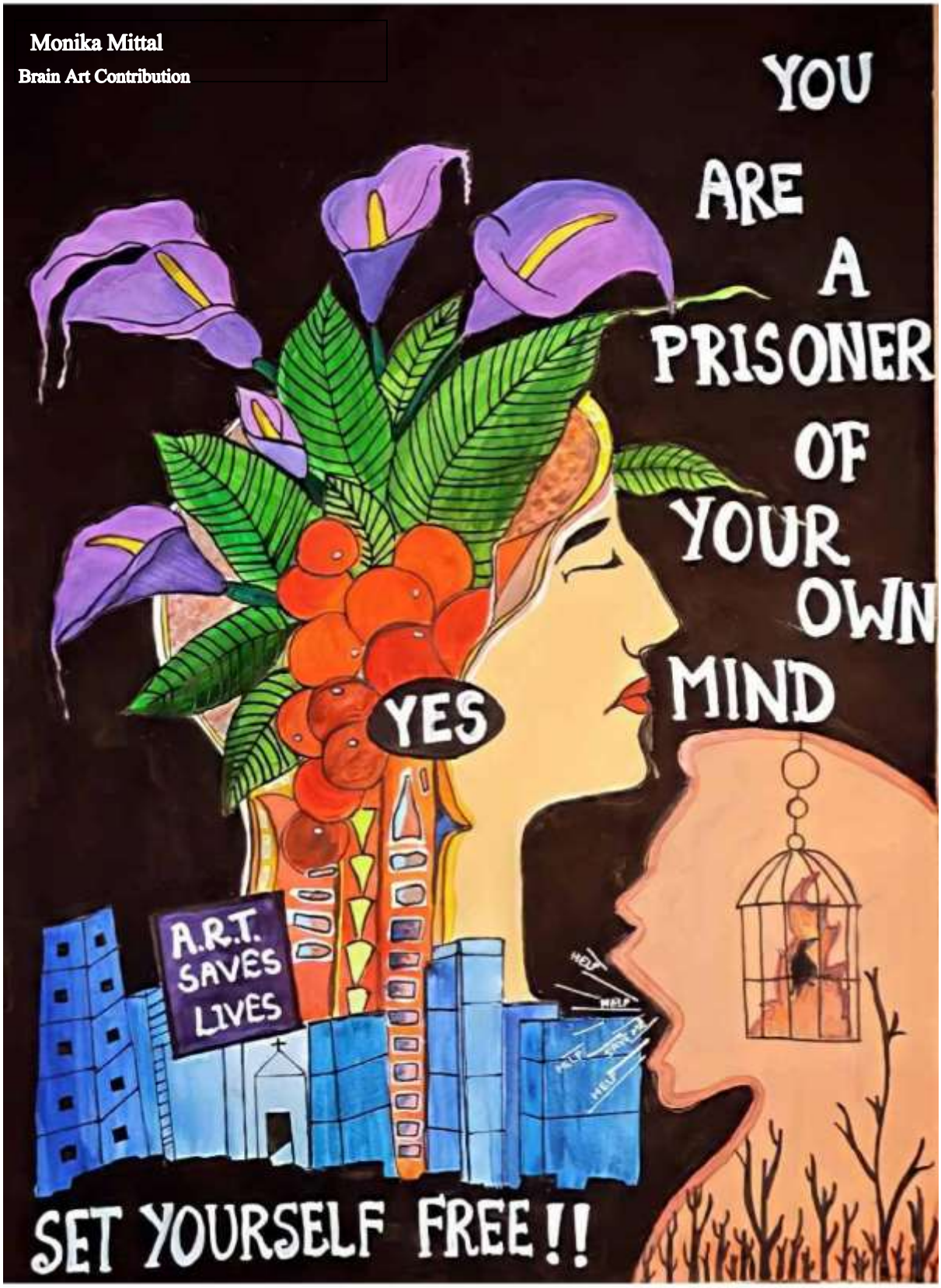
AMMACHI (Amrita Multi Modal Applications and Computer Human Interaction) Labs has been at the forefront of HCI based innovation that has successfully attempted to bridge the gap in vocational skills training in India using technology.
The holistic approach adopted by AMMACHI Labs research, designs and implements educational and training content through its innovative Computerized Vocational Educational and Training (CVET) courseware. Utilizing a blend of modalities such as haptics enhanced simulators, tablet-based MOOC style multimedia content, and serious games, combined with pedagogical strategies on the ground such as blended and peer to peer learning techniques, AMMACHI Labs has provided a successful formula for bringing technology and learning to the most marginalized members of society. From designing haptic interfaces to simulate force-feedback akin those felt while using a physical tool in real-time, to UI/UX that can be navigated by an individual with little to no literacy or computer skills, the efforts that have gone into the making the platform and tools that is today being used all across India, that is accessible to participants with no technology exposure and has been instrumental in training hundreds of thousands across the country.

This talk aims to summarize the pathbreaking technological innovation for vocational training and social upliftment while also sharing the challenges faced while developing the technology and solutions learned.

Bhavani Rao is the Director of Amrita Multi Modal Applications Using Computer & Human Interaction Labs (AMMACHI Labs) and the Center for Women's Empowerment and Gender Equality (CWEGE), two research centers within Amrita Vishwa Vidyapeetham, a top-ranked private university in India. She is Dean of the School of Social and Behavioural Sciences and has been designated as India's only UNESCO Chair in Gender Equality and has extensive experience in technology-based women's empowerment projects throughout rural India, funded by international and national agencies (including UNESCO, UNDEF, UNICEF, and the Government of India). She is the author of 105 publications, numerous patents related to vocational skills and haptics, and has received many awards, including the "50 Education Innovative Leaders" in 2019.


Monika Mittal
Brain Art Contribution
YOU ARE A PRISONER OF YOUR OWN MIND
YES
A.R.T. SAVES LIVES
HELP
SET YOURSELF FREE!!

ACCS8
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PRESENTATIONS

Consciousness is an invention, neither a hard neither an easy problem, never an illusion. Consciousness it's not the explanandum, consciousness is the explanans.

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As today's neuroscientists suppose, if consciousness is a neural process that is inside the head and separate from the physical world it perceives, the phenomenal experience is hard problem. However, if phenomenological characteristics of co-occurring brain activity with consciousness mental states and things out there are one and the same, consciousness is neither a hard neither an easy problem, just explain how each of your experiences is in the outer world, is the outer world. There is no experience separate from the physical world perceive.

Section1. Introduced Nagel's Idea That Mental States Like Sensations and experiences (and mental states like the phenomenological elements of attitudes), in contrast with cognitive mental states (the so-called propositional attitudes), have a tripartite essence -phenomenological, physical and functional.

Section 2. exemplify a test empirical research on the brain. If concepts like "cognitive" and "cognition", "binding" and "attention", "semantic",“encode”,"processing" and "information" are replaced by “something”, the related empirical results(that allegedly use these concepts) will be statistically the same or not? If the related Empirical Results (allegedly related to what we are supposed to refer to through these concepts) are statistically the same, the empirical research on the brain will be “allegedly empirical research on brain “and these concepts are as idiomatic as Nagel's “know how to be a bat “erroneously perceptually imagine (instead of empathetically imagine).

I conclude that a physicalist reduction sensation may turn out to be
Superable and that phenomenological characteristic of co-occurring brain activity with consciousness mental states and things out there are one and the same.

Keywords:
Sensations; experiences; functional magnetic resonance(fMRI); phenomenological characteristics; types of brain activity; conscious mental states; p value; Bayes factor; the philosophical problem of hardness of consciousness disciplined and informed by the Neuroscience if and only if Neuroscience is disciplined and informed by the Philosophy Mind.

Positive, not negative, emotions facilitate response inhibition under high load

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Background:
A significant part of everyday social life involves attending to emotional stimuli that help make appropriate decisions. Emotional stimuli also help evaluate decisions and make dynamic changes as per changing environment, such as cancelling an action when it is no longer needed or appropriate. This ability to cancel an initially planned action is known as response inhibition. Thus, it is critical to understand how emotional stimuli influence response inhibition. Previous studies have only manipulated emotional expression to study response inhibition (Pessoa et al., 2012). None of the studies simultaneously manipulated the level of attention (high vs. low) and emotion (positive vs. negative) to examine the interactive effect of emotion and attention in response inhibition. Notably, positive and negative emotions interact with attention differently (Gupta, Hur, & Lavie, 2016); the valence of emotional stimuli modulate emotional capture differently under high versus low perceptual load. Here, we simultaneously manipulate both attention and emotion to examine the interactive effect of emotion and attention in response inhibition in a stop-signal task. It has been suggested that the processing of irrelevant positive emotions requires fewer attention resources than irrelevant angry emotions. Therefore, we hypothesized that under high perceptual load, the stop signal's irrelevant positive emotional information would leave enough resources for response inhibition than irrelevant negative emotional information, facilitating response inhibition.

Method:
We used a modified version of the stop-signal task where we manipulated perceptual load of go signal (low, high) and emotional information of stop signal (arousal matched positive and negative IAPS images in Exp 1; happy, angry, and neutral faces in Exp 2). In the go trials, one target letter (X or N) and five nontarget letters (all O in the low-load and H, K, W, M, Z on the high-load) were presented in random order around the fixation. Participants were required to search the letter array for a target letter (either X or N) and make a speeded response. On 30% of total trials, after go-signal, a stop-signal (IAPS image in Exp 1, facial expression in Exp 2) appeared at the center of the screen that instructed subjects to withhold their responses. The delay between go-signal onset and stop-signal onset is called stop-signal delay (SSD). The SSD was adjusted dynamically throughout the experiment, such that if subjects successfully inhibited their response on a stop trial, the SSD was increased by 50 ms on a subsequent stop trial, and if they failed to inhibit their response, the SSD was reduced by 50 ms on a subsequent stop trial. 15 volunteers performed Exp 1, and 29 volunteers performed Exp 2.

Results:
To investigate inhibitory control, the stop-signal reaction time (SSRT), which provides an estimate of the "inhibitory reaction time," was calculated for each stop-signal condition separately for low and high load condition. In Exp 1, the main effect of emotion of stop-signal was marginal significant, $F(1, 14) = 4.20$, $p = 0.056$, $\eta p^2 = 0.19$. Pairwise comparisons showed that SSRT were marginal significantly lower for positive stop-signal images compared to negative stop-signal images, $t(14) = 2.05$, $p = 0.056$, $d = 0.48$. We also found an interaction effect of load and emotion on SSRT, $F(1, 14) = 4.54$, $p = 0.048$, $\eta p^2 = 0.21$. Pairwise comparisons showed that in high load condition, SSRT were significantly lower for positive stop-signal images (M = 315.77 ms, SD = 104.5 ms) compared to negative stop-signal images (M = 342.58 ms, SD = 100.5 ms), $t(14) = 2.9$, $p = 0.03$, $d = 0.41$. There was no significant difference in low load condition, $p > 0.6$. In Exp 2, the main effect of emotion of stop-signal was significant, $F(2, 48) = 4.67$, $p = 0.014$, $\eta p^2 = 0.16$. Pairwise comparisons showed that stop latencies

(SSRT) were significantly lower for happy face stop signal compared to angry face stop signal, $t(24) = 2.94$, $p = 0.015$, $d = 0.58$. There was no difference between angry-neutral, $t(24) = 0.77$ $p = 0.9$, $d = 0.15$, and happy-neutral face condition, $t(24) = 2.17$, $p = 0.07$, $d = 0.36$. We again observed an interaction effect of load and emotion on SSRT, $F(2, 48) = 3.46$, $p = 0.039$, $\eta p^2 = 0.12$. Pairwise comparisons showed that in high load condition, SSRT were significantly lower for happy face stop signal (M = 298.6 ms, SD = 104.5 ms) compared to angry face stop-signal (M = 347.9 ms, SD = 100.5 ms), $t(24) = 4.47$ $p < 0.001$, $d = 0.89$, and neutral face stop signal, $t(24) = 2.11$, $p < 0.045$, $d = 0.42$. The stop latencies were similar for the stop-signal with neutral facial expression and the stop-signal with angry facial expressions, $t(24) = 1.6$, $p = 0.12$, $d = 0.32$. Within low load condition, none of the comparisons were significant ($p > 0.48$, for all).

Discussion:

The result showed a consistent pattern of interaction of load and valence across the two experiments involving highly arousing positive and negative images (Exp 1) and happy, angry, and neutral facial expressions (Exp 2). Emotional stop-signal led to no difference in inhibitory performance under the condition of low load. However, under high perceptual load, positive stop-signal consistently improved inhibitory control compared to negative stop-signal. As results were generalized across different categories of emotional stimuli (images and faces), they highlight the general role of overall emotional valence while ruling out alternative accounts in terms of different visual appearance or semantic content between negative and positive stimuli. We offer two explanations of these results. Gupta et al. (2016) argued that positive emotion could capture attention even in high-load situations. Thus, the capture of attention by positive emotion stop-signal might have led to stop-signal's more robust perceptual representation and greater ability to stop the ongoing motor plan. Alternatively, the processing of irrelevant positive emotions requires fewer attention resources compared to irrelevant angry emotions. Therefore, under high perceptual load, irrelevant positive emotional information of the stop-signal would leave enough resources for response inhibition than irrelevant negative emotional information, which would facilitate response inhibition. Overall, the present results suggest that the valence of emotional information needs to be considered together with the level of perceptual load in determining the influence of emotional information on inhibitory control. These results may have theoretical implication for interventions for drug addiction. A positive approach will be more effective to counsel drug addicts and prevent further relapse.

Keywords:

Attentional load, emotion, response inhibition, happy faces

Cross Cultural Evaluation of Emotional Words on an Indian Population

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Ratings of affective experience are widely used in cognition and emotion research. Currently, there is neither a standard database of affective words for use in research with the Indian population nor information about the way Indians rate their affective experience to emotional words. Our study's primary objective was to conduct a cross-cultural evaluation of the ratings between the Indian and western population as an attempt to know how the Indian population responds to emotional words in terms of arousal, valence and concreteness. This study aims to record the Indian affective experience of emotional words and investigate whether self-reported Indian ratings are comparable to the western normative ratings to evaluate their usability in the context of Indian research. We conducted a survey involving 48 Indian participants (age range = 19-27, M = 21.96, SD = 1.84, 28% females). A corpus of 50 emotional words of varying hedonic and arousing content were given to the participants in this study. Similar to the data collected from the western sample, we instructed our participants to rate their affective experience of valence (how pleasant or unpleasant) and arousal (how calm or excited) for each emotional word on a 9-point self-assessment manikin (SAM) scale and rate concreteness (how abstract or concrete) on a 5-point self-assessment manikin (SAM) scale. Our study is novel in the terms that no other study has evaluated the affective ratings as well as concreteness ratings for emotional words for an Indian population and compared with the western population. This helps us understand how differences in culture can lead to differences in how one might understand emotional words. The results indicated that the Indian population was similar to western population in terms of valence ratings but showed significant differences in arousal and concreteness ratings. The western and the Indian samples agreed on valence ratings but disagreed on arousal ratings. Our population sample showed higher arousal and concreteness ratings for emotional words compared to the western counterpart. There were significant correlations between the two groups of population with highest for valence, reasonably high for arousal and least for concreteness. Analyzing dimensions together revealed a significant positive correlation between arousal and valence for both populations but no significant correlation of concreteness with valence as well as arousal for both populations.

Does Case Marking influence the Timing of Verb Retrieval during Sentence Production?

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Verb retrieval constitutes a critical step during sentence formulation. There are two views on the timing of verb retrieval. The first view assumes that the verb is needed for grammatically formulating the arguments of a sentence [1, 2, 3]. Hence, it is crucial to retrieve the verb early, irrespective of its position (e.g., SVO vs SOV) in the linear order of the sentence. The second view assumes that arguments can be grammatically encoded verb independently by relying on the conceptual message of the sentence [4, 5]. Under this account, verbs can be retrieved on a just-in-time basis, prior to their articulation in the sentence. However, there is mixed evidence in support of the two views. For example, [6] found that the verb is retrieved early in SVO languages, but just-in-time in SOV languages. In contrast, evidence from [7, 8] shows that that the verb is retrieved neither early nor just-in-time, but rather before the internal argument(object) of the sentence for both SVO [7] and SOV [8] languages. The current work tries to test these divergent hypotheses via the phenomenon of split-ergativity in Hindi, an SOV language.

In Hindi, nominal arguments precede the verb and these arguments are differentially case marked due to the property of split-ergativity. Usually, ergative case is assigned to subjects of transitive verbs in the perfective aspect while nominative case appears in imperfective aspects (E.g., 1 and 2). Critically, ergative case assignment is to a certain extent also governed by the idiosyncratic lexical properties of the verb. For example, subjects of some verbs do not take up the ergative marker even in the perfective aspect (E.g., 3 and 4). One consequence of this could be that verb retrieval must precede the formulation of an ergative-marked subject and that conceptual information alone will not suffice. In contrast, nominative case assignment in non-perfective aspects is more regular and conceptual information about event telicity may suffice. In this work, we investigated if differential case marking modulates the timing of verb retrieval in Hindi.

The question was investigated using the extended Picture-Word-Interference Paradigm (ePWI) [7]. Participants described images of transitive events in simple sentences. Superimposed upon the images were words that were either semantically related or unrelated to the target verb. Previous findings using the ePWI paradigm have been that speakers are slower to begin speaking sentences in the related and not in the unrelated distractor condition. This is known as the semantic interference effect which arises when semantically related words create a competition during lexical retrieval while unrelated words do not [9]. This competition leads to a delay in speech onset. An observed semantic interference effect at speech onset can thus indicate whether the verb was retrieved early or not.

The experiment had a 2 x 2 factorial design crossing Distractor-type* (related vs unrelated) and Case-type (ergative vs nominative). Distractor-type was a within-subject factor while Case-type was a between-subject factor. Two groups of participants (n=60**, 30 for each Case-type) participated in the experiment. The subject was always the first word in the sentence. The dependent variable was the speech onset latency. If differential case assignment guides verb retrieval, then we expected to observe an interaction between Distractor-type and Case-type such that, there should be a significant difference in speech onset between the related vs unrelated conditions (related should be slower) in the ergative case conditions, while no difference should be observed in the nominative case conditions. However, if verb retrieval and the type of case assigned are unrelated then we expected to see either a main effect of Distractor-type (indicating early retrieval irrespective of case) or no effect of Distractor-type (indicating that the verb is not retrieved early)***.

Linear mixed-effects models were used for all analyses; maximal models were fitted to the extent supported by the data. Onset latencies were log-transformed. The results reveal a main effect of Distractor-type (Related =1138 ms; Unrelated=1092 ms; $t=2.8$; $p<0.01$) and Case-type (Ergative=1134 ms; Nominative= 1095; $t=3.1$; $p<0.01$). The interaction was not statistically significant. The findings

thus suggest that verbs are retrieved early in Hindi irrespective of which case is assigned to subjects, signalling that argument formulation is verb centric.

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*Only those image-distractor pairs were included that showed a reliable interference effect in two norming studies (n=28) conducted prior to the actual experiment.

**The number of participants was decided based on a power analysis following the procedure specified in [10]

***The hypothesis, study design, analysis plan and other details were preregistered at OSF

Examples:

1. bachchi-ne pehelwaan-ko pukaar-aa
   child-ERG wrestler-ACC call-PERF
   (The child called the wrestler)
2. bachchi-ϕ pehelwaan-ko pukaar rahi hai
   child-NOM wrestler-ACC call PROG be.PRES
   (The child is calling the wrestler)
3. bachchi-ϕ phal laay-ii
   child-NOM fruit bring-PERF (The child brought fruits)
4. bachchi-ϕ pehelwaan-se mil-ii
   child-NOM wrestler-ABL meet-PERF (The child met the wrestler)

Conditions:

(a) Related, Ergative (E.g.,1)
(b) Unrelated, Ergative (E.g.,1)
(c) Related, Nominative (E.g., 2)
(d) Unrelated, Nominative (E.g., 2)

Each participant saw both related and unrelated versions of an image. In the ergative condition, participants were asked to describe images as if the action has been completed (perfective aspect). In the nominative condition, participants were asked to describe images as if the action is going on (progressive aspect).

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Reversibility and Rationality in Jean Piaget's Theory of Reasoning

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Rationality has long been considered to be the quintessence of humanity. However, beginning in the second half of the 20th century, psychological experiments have revealed reliable divergences in performance on reasoning tasks from the normative principles of reasoning (Johnson-Laird 2006, p. 17; Wason 1966; Wason and Johnson-Laird 1972), which have cast serious doubt on the venerable dogma that humans are rational animals (Samuels et al. 2004, 2012; Samuels and Stich 2006).

According to Edward Stein, the standard picture of rationality is as follows:

to be rational is to reason in accordance with principles of reasoning that are based on rules of logic, probability theory, and so forth. If the standard picture of reasoning is right, principles of reasoning that are based on such rules are normative principles of reasoning, namely they are the principles we ought to reason in accordance with (Stein 1996, p. 4 Author's italics)

Stein (1996, p. 4) dubbed the opposing positions in the rationality debate 'rationality' and 'irrationality thesis':

the rationality thesis says that human reasoning competence matches the normative principles of reasoning (that is, the rules embodied in our reasoning competence are the same as those that we ought to follow), while the irrationality thesis says that human reasoning competence diverges from the norms (that is, the rules embodied in our reasoning competence are different from those we ought to follow). (Stein 1996, p. 10)

Advocates of the rationality or irrationality thesis differ in their interpretation of the experimental results, and the difference in the theses turns on the relationship between reasoning competence and the norms. Whilst both those pro and contra acknowledge a performance-competence distinction, they differ in their interpretation of the significance for the underlying competence of the experimentally documented performances that do not conform with the normative principles of reasoning:

Defenders of the rationality thesis say that all divergences from the norms of reasoning are performance errors and, as such, these divergences are not indicative of an underlying ability to reason. Defenders of the irrationality thesis agree that the competence-performance distinction is applicable to the realm of reasoning, but they deny that our reasoning competence matches the norms of reasoning; they offer alternative accounts of human reasoning competence, accounts according to which we are not rational. (Stein 1996, p. 10)

The main strategy of defenders of the rationality thesis is to explain away experimental evidence as performance errors. The rationality thesis thus immunises itself against such evidence by means of the performance-competence distinction. For advocates of the irrationality thesis, in contrast, performance in the reasoning experiments cannot be discarded as errors; rather, they reveal competence, i.e., the real nature of human reasoning. However, it is debatable whether the irrationality thesis can be justified on the basis of such experimental evidence—any argument worthy of consideration must surely be rational! (Cohen 1981; Hanna 2006, pp. 128–30).

On the other hand, rational grounds in favour of the rationality thesis are also surprisingly thin. Stein sums them up as follows:

The main virtues of the standard picture of rationality are that it accounts for the (seeming) normativity of rationality, that it is intuitively plausible and simple, and that it coheres well with such well-established disciplines as logic and mathematics. (Stein 1996, p. 247)

Scaremongery also bolsters the case for the rationality thesis:

Another reply in defence of the standard picture of rationality is to point out that rejecting the standard picture leads to such undesirable results as rampant inconsistency, Dutch-book ability, and so forth. Any picture of rationality that rejects the conjunction principle, the modus ponens principle, and similar principles of reasoning—principles of reasoning that the standard picture says are norms—is sure to run into profoundly problematic results … These results are not just bad in that they fail to fit with our intuitions; they are bad in that they seem to threaten the very practice of reasoning. (Stein 1996, p. 252)

In summary, the standard picture of rationality provides the backdrop for both the rationality and irrationality theses and by virtue of the competence-performance distinction diametrically opposed interpretations of the results of reasoning experiments are possible.

However, the standard picture rests on shaky foundations. Rather than attempting to immunise rationality against empirical evidence by interpreting divergences from the norms of reasoning as performance errors, advocates of the rationality thesis could change tack and pursue a course that undermines the standard picture. (Stein 1996, pp. 214–5).

Jean Piaget (e.g., Piaget 1957, 2001; Piaget and Beth 1966; Piaget and Grize 1972; Winstanley 2021) developed a psychological theory of reasoning, in which logic and mathematics are continuous with psychology but nevertheless autonomous sources of knowledge. Logic, probability theory, etc. are therefore not extra-human norms and reasoners are able to reason in accordance with them. Piaget's theory of reasoning therefore has the intuitive appeal of the standard picture; however, I will argue that this is accidental to his theory of rationality. In particular, I will argue that Piaget charts an alternative course to rationality that undermines the standard picture by denying that the norms of reasoning based on logic, probability theory, etc., are psychologically relevant for rationality rather than by rejecting them.

Piaget's theory of rationality is based on the reversibility of operations of thought rather than on reasoning in accordance with rules based on logic, probability theory, etc. In this paper, I will set out and illustrate Piaget's theory of rationality on intra- and interpropositional reasoning.

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Electrical vestibular nerve stimulation: An alternative therapy to improve spatial and verbal memory in patients with Parkinson's disease

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Background:
Progressive impairment of spatial and verbal was reported in patients with Parkinson's disease. Vestibular stimulation was reported to improve the spatial and verbal memory scores through its connections with areas of the brain related to the cognitive functions.

Aim:
The present study was undertaken to observe the effectiveness of electrical vestibular stimulation as an alternative therapy on spatial and verbal memory scores in patients with Parkinson's disease.

Materials and methods:
30 cases with PD, including both males and females were recruited in the study by convenient sampling after obtaining written informed consent. Patients were randomly assigned to control and intervention groups with 15 participants in each group. After recording baseline spatial and verbal memory scores, electrical vestibular stimulation was administered as an alternative therapy to the participants in intervention group for 6 weeks. Sham stimulation was administered as an alternative therapy to control group participants for 6 weeks. After 6 weeks the spatial and verbal memory scores were recorded and compared.

Results:
Baseline values of verbal memory and spatial were not statistically significant between control and intervention groups. Post intervention verbal memory scores were significantly improved in the intervention group when compared to control group ($P<0.001$). Post intervention spatial memory scores were significantly improved in the intervention group when compared to control group ($P<0.05$).

Conclusion:
The study results are in accordance with earlier studies as there is a significant improvement in spatial and verbal memory scores. The study recommends further detailed studies to support implementation of electrical vestibular stimulation as an adjunctive therapy in the management of Parkinson's disease.

Key words:
Parkinson's disease, Memory, Vestibular stimulation. Acknowledgement: The study was funded by Indian Council of Medical Research (2020- 1352)

Numerosity based Go/No-go task Performance influenced by Subitizing and Estimation range but not Relative Numerosity

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The Go/No-go task is used to study voluntary control in humans. But only a few studies are done along with the numerosity. In this study, we explore and understand the interaction of different numerosities with executive control; we designed two different experiments by modifying the Go/No-go task.

In experiment 1 (n=30), we have designed a go/no-go task based on relative numerosity comparison judgment. First, we have adapted participants to the reference numerosity, i.e. 13 for over 30 seconds to 1 minute. The adaptation block consists of 30 displays; each has the same number of dots. In the test block, following the adaptation block, for each trial(2000ms), participants compare the displayed numerosity with the reference numerosity and respond accordingly. We have drawn two conditions: lesser numerosities are go stimuli, and greater numerosities are no-go stimuli or vice-versa (named as smallgo and largego, respectively, for simplicity). Lesser numerosities are 4, 7, and 11, and greater numerosities are 15, 18, and 21. The go and no-go trial ratio is 7:3. The total number of trials is 400, 200 for each smallgo and largego condition. We have computed d-prime(d') for two conditions separately. Results do not show any difference between smallgo and largego conditions. Results show a decreasing pattern in block-wise d-prime but not a significant one

(F (1,270) =2.12, p=.14), which can result from a decrease in adaptation effect over time.

In experiment 2 (n=36), we have eliminated the adaptation block and designed the task based on absolute numerosity judgment. We have chosen two numerosity sets: small numerosity- 1 to 5 and large numerosity- 11 to 20. Based on these, we derived two conditions: taking small numerosity as a go stimulus and large as a no-go, and large numerosity as a go stimulus and small as a no-go. We have maintained the values of other variables like number of trials, ISI, number of blocks, and the ratio of go/no-go trials, from experiment1. We computed, again, d' for this experiment. A two-way analysis of variance yielded a main effect for two conditions (smallgo and largego), $F(1,350)=9.94, p=.0018$, such that the d' value is significantly higher for the smallgo than the largego. This suggests that participants are more confident and accurate in smallgo conditions, whereas less accurate in largego conditions implicate executive processes.

Keywords:
Go/No-go, Enumeration, Executive control, Psychophysics, Human-Behaviour

On-center off-surround RNN model for enumeration in natural images using saliency maps

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Though our understanding of numbers and mathematical knowledge is structured by semantics and a set of acquired knowledge, infants and animals are also observed to have a number sense, which suggests the presence of an inherent mechanism for numerosity perception in humans and animal brains. Sengupta et al. (2014) suggested an on-centre off-surround recurrent neural network model for number perception. The RNN model was able to explain some of the major behavioural findings regarding Weber fraction, number comparison and reaction times. In our current work, we propose an enumeration model which follows a bottom-up approach to enumerate objects present in natural and simulated images. To construct this end-to-end model, we have extended the RNN model from Sengupta et al. (2014) by introducing some additional structures at both ends, before the input and after the output. To use real images as the input for the network, we generated saliency maps for them using some well-known methods such as AIM (Neil D. B. Bruce et al.2009) and RARE2012(Riche et al.2013). While modifying the saliency map to fit as an input for the model, we chose to perform only simple operations, keeping the process minimal and not too distant from biologically relevant processes. First, we modified the data by applying a threshold, making less salient regions have zero magnitudes, then we remapped the saliency map to fit the dimensions of the network (currently using 64 cells). In the last step, we normalize the data to have values from 0 to 1 as the network requires. We used these 64 values as the input current for the neurons in the RNN. After the network reaches a steady state, we calculate the mean activation of neurons.

As suggested in Sengupta et al (2014), when mean activation increases monotonically with numerosity, it can be standing as a basis for magnitude comparison in the brain for enumeration tasks. Based on this hypothesis we have formulated a method to retrieve the numerosity from the mean activation of the network. For each image we compare their mean activation with the known relation between numerosity, inhibition value, and mean activation, which gives us the corresponding numerosity. One of the main contributions of the paper is the finding that a simple on-centre off-surround neural network can be used for both large (estimation range) and small (subitizing range) numerosity perception by adjusting its inhibition value. A network with a lower inhibition is found to be suitable for estimating large numbers, and vice versa. Using a set of images, we tested the network with inhibition values; medium (.05) and high (.15). By comparing the accuracy of the output numerosity, we observed that the network with high inhibition produces a more accurate result (relative error:0.33 vs 1) in comparison to low inhibition for the images with a smaller number of objects, which corroborates the claim from the paper. Our model follows a bottom-up approach for enumeration and gives favourable results for the images, primarily with a small number of spatially well-separated objects. The model's design has scope for a top-down mechanism for a more accurate and biologically relevant enumeration in natural images.

How do bad memories and ability to judge Morality affect deceptive Behaviour?

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Autobiographical memory for deceitful events is said to be forgotten over time to reduce guilt and stress. People who engage in deceitful behaviour continue to do so because they are able to stretch their memories to match their moral outlook. In our study, we wanted to see if participants who engage in deceitful behaviour will change their behaviour if they are reminded of their previous misdeeds. We also wanted to see if the moral Competence of a person affects deceptive behaviour. A suitable game (Flappy Bird) was designed to measure deception quantitively. Participants played this game in which they have to self-report their scores to stand a chance to win a reward. Participants have 80 trials divided into 4 blocks (20 trails each). They were asked to report their highest score after 20 trials. Their actual scores were not displayed and is monitored in the background. The difference between the reported score and the actual score is the quantitative measure of deception we call deceit score. In the first experiment, we tested the effects of autobiographical memory on deceitful events using the Autobiographical memory characteristics questionnaire which reminds the participants of their memories. The AMCQ is administered between the 2nd and 3rd block of the game. Using the same experimental design, we tested for the effects of moral competence on deceit score in the second experiment. The Moral Competence Test (MCT) was administered to measure the moral democratic competence of a person measured as C-Index. A repeated-measures ANOVA was computed between and within the groups who wrote neutral and deceitful memories, no statistically significant effect was found $f(3,54) = 2.198$, $p = 0.099$, ns and $f(1,56) = 1.962$, $p = 0.167$ respectively. Results of the first experiment showed that for both neutral and moral conditions there seems to be an increase in Deceit score but there is a sharp increase in the group which reported deceitful memory. In the second experiment, repeated measures Anova showed a statistically significant effect of morality on deceptive behaviour $f(3,47) = 3.973$ and $p= 0.013$. Paired T-test was computed between the average deceit scores before MCT and After MCT. There was a significant difference in the scores for before MCT ($M = 7.6306$, $SD = 13.5366$) and After MCT ($M = 22.4571$, $SD = 38.9411$); $t(51) = -3.621$, $p = 0.001$. We saw an increase in deceptive behaviour. No correlation was found between the C-Index and Average Deceit score.

Mathematical Modelling of Biochemical Networks in Neurodegenerative Diseases

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Modelling of biochemical networks such as signal transduction and gene regulatory circuits are main components of modern systems biology. In the case of experimentally immeasurable biological processes, a mathematical model can be used to observe and analyze the behaviour of a particular variable. The behaviour of these hidden system states can be crucial to understand the performance of biological systems where measurement is difficult or impractical. The applications of mathematical modelling have particular relevance to study diseases such as Parkinson's disease (PD) and Alzheimer's disease (AD), which are unique to the human brain and for which animal models reproduce only certain pathological features. In this study, we present a computational model of Parkinson's and Alzheimer's disease that include different biological interactions that lead to neurodegeneration, with the application of biochemical systems theory (BST). Pathways were modelled using stochastic differential equations by incorporating kinetic laws and their initial conditions for the modelled proteins were obtained from literature. The model provides a comparison between the species regulations and their behaviour in both the diseased and normal states. The modelling shows that mutations in some of the proteins such as αsynuclein (αS), amyloid beta (Aβ), and tau share common pathophysiology in both AD and PD. These proteins along with TNFα, reactive oxygen species (ROS) and other kinases can induce oxidative stress in neurons that trigger apoptotic pathways. Simulations suggested insulin resistance as a key mechanism that could trigger and modulate common signalling pathways observed in AD and PD such as neuroinflammation and oxidative stress. It is also associated with the variations in cellular concentrations of αS, Aβ and tau and led to accumulation of toxic cellular oligomers and neuron degeneration. Mapping cellular level predictions from this model to clinical symptoms and cognitive deficits of AD/PD would help clinicians to diagnose the disease and initiate an early-stage treatment to delay the progression.

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The graded rise of inflammatory markers in hippocampus induced by intracerebroventricular streptozotocin (STZ) injection at increasing time points showed correlations with some memory impairments in rats

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Background:
Intracerebroventricular (ICV) injection of streptozotocin (STZ) in rats induces neuroinflammation and dementia similar to Alzheimer disease (AD), and it is used as a rodent model of sporadic AD (ICV-STZAD). The relation between neuroinflammation and memory impairments in ICV-STZ-AD rats is not clearly understood. Most of the investigators reported increased neuroinflammatory markers in brain and memory impairments after 2-4 weeks of ICV STZ injection in rats. If the levels of inflammatory markers in brain or hippocampus are measured with concomitant changes in memory parameters at different time points after ICV STZ injection, the role of neuroinflammatory markers on memory impairments may be investigated.

Aims and objectives:
The present study was designed to investigate the relation between neuroinflammatory markers in hippocampus and memory impairments in ICV-STZ-AD rats at different time points after ICV-STZ injection. Working memory errors (WME), reference memory errors (RME), latency to enter first baited arm (L1B) and latency to enter four baited arms (L4B) were measured in a Radial Arm Maze (RAM) along with the concomitant levels of COX2, PGE2, TNFα, nitrite and iNOS in hippocampus at 3rd hour, 24th hour, 7th day and 21st day after ICV STZ injection in rats, and the results were compared with that of sham-operated (ICV artificial CSF injection, aCSF) and control rats (without any injection).

Methods:
Memory parameters (WME, RME, L1B, L4B) were measured after habituation (5 days) and training (15 days) for 5 days (as testing) before ICV STZ / aCSF injection, and at 3 rd hour, 24th hour, 7th day and 21stday after ICV STZ or aCSF injection in rats. STZ (10µl containing 3mg STZ/kg body wt. in aCSF) or aCSF (10µl) was injected stereotaxically in the lateral ventricles of both sides of rats. TNF-α, COX2, PGE2, nitrite and iNOS in hippocampus were assessed by ELISA kits at the same time points in ICV- STZ-AD, sham-operated and control rats.

Results:
WME and RME were increased at 24th hour,7th day and 21st day after ICV STZ injection and the errors were progressively elevated with time. The rats stopped movements at 3rd hour after ICV STZ injection and the memory parameters could not be measured. But the ICV artificial injected rats (sham-operated rats) showed pre-injection values of WME and RME at all the points including 3rd hour after injection, which were similar to control rats. WME, RME and L4B were increased progressively from 6th day to 21st day after ICV STZ injection in 21-day study. The neuroinflammatory markers (TNFα, COX 2 PGE 2, nitrite and iNOS) in hippocampus were increased at all the time points after ICV STZ injection and the levels of these inflammatory markers showed graded increase with time. The time dependant changes of WME and RME were correlated with the graded increased levels of the observed hippocampal inflammatory markers, but L1B and L4B were not correlated with these markers.

Conclusion:
The increased levels of neuroinflammatory markers at 3rd hour after STZ injection showed profound effects on rat's behavior including impairments of memory and movements, but it was not due to an injection shock as the sham-operated rats (ICV aCSF injection) were not affected in this way after injection. WME and RME appear to be sensitive to the hippocampal level of inflammatory markers. Probably the neural circuitries for WME and RME through hippocampus are increasingly affected with higher levels of inflammatory markers.

Keywords:
Working memory error, Reference memory error, COX2, PGE2, TNFα, iNOS, nitrite, Alzheimer's disease.

Acknowledgement:
This research work has been funded DST, CSRI, Govt. Of India [Reference No.SR/CSRI/353/2016(G) dt.24.4.2017]

*Resting-state functional MRI connectivity alterations related to cognitive changes in intracranial dural arteriovenous fistulas before and after embolization treatment

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Background and purpose:
Intracranial dural arteriovenous fistulas (DAVF) are characterized by arterio-venous shunts at layers of the dura, which are caused by pathologically abnormal enlargement of physiological arterio-venous (AV) shunts or by development of neo-angiogenesis or both. Cognitive decline and dementia are common aggressive, non-hemorrhagic complications of intracranial dural arteriovenous fistula (DAVF). Dementia associated with DAVF is reversible after early endovascular management. No single imaging predictor for the initiation, progression, reversibility of the cognitive decline in DAVF has been described yet. Resting state functional magnetic resonance imaging (RS-fMRI) is a promising imaging research tool that shows functional connectivity (FC) changes and interaction among resting-state networks in cognitive disturbances and dementia. Interaction among resting-state functional networks offers an understanding of symptom manifestation, disease-specific FC changes, to uncover pathological mechanisms, and to detect early changes, the severity of many neurodegenerative disorders. This study evaluates the resting state networks (RSNs) FC changes associated with DAVF and its correlates in reversible cognitive decline after treatment.

Materials and Methods:
Resting-state functional MRI (RS-fMRI) was performed in 33 participants with DAVF and 33 healthy controls (HC). One-month post embolization RS-fMRI was performed in 20 participants with DAVF. The FC analysis (p-FDR corrected < 0.05) between regions of interest (ROI) was done. Neuropsychology (NP) scores between patients pre-and post-embolization at one month were also compared with HC and correlated with FC changes.

Results:
RS-fMRI showed reduced FC at the pre-cuneus-posterior cingulate cortex (PC-PCC) of default mode network (DMN), anterior cingulate cortex (ACC)of the salience network (SN), and compensatory increased connectivity at the frontoparietal network (FPN) and dorsal attention (DAN) network (p-FDR<0.05). DAVF with low NP scores showed significantly reduced FC at DMN & SN and minimal or absent increased connectivity at FPN & DAN (pFDR <0.05). On post embolization follow-up, improvement in FC at PC-PCC of DMN & ACC of SN and less prominent FC at FPN & DAN (p-FDR <0.05) were noted.

Conclusion:
RS-fMRI in DAVF shows FC changes correlated to cognitive decline and its early reversibility after treatment. Strength of functional connectivity changes at DMN, SN, FPN, and DAN, correlates with the level of cognitive decline and the neuropsychology scores

Abbreviations:
DAVF= Dural arteriovenous fistula, HC= Healthy controls, DMN= Default mode network, SN= Salience network, FPN= Fronto-parietal network, DAN= Dorsal attention network, NP= Neuropsychology, PCPCC= precuneus-posterior cingulate cortex, ACC- Anterior cingulate cortex, P-FDR, and P-FEW= Pfalse discovery rate and P-family wise error.

Decoding hand grasped movement with EEG: Characterizing gamma oscillations, temporal biomarkers and other cortical potentials.

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Recent advancements in neuro-prosthetics have shown promise to improve the quality of life for people with motor impairments. Futuristic devices that are controlled by thoughts and using Brain-computer interfaces (BCI) will be a great aid Activities of Daily Living (ADL). Decoding such motor tasks and their significance in non-invasive brain-computer interfaces were well studied from the recent past for rehabilitation and to understand the dysfunctions. (Daly and Wolpaw, 2008; Iyengar et al., 2009; Leocani et al., 2001). There is little information related to cortical zone-dependent microstates and their movement-related cortical potential (MRCP) (Saitou and Washimi, 1997; Shakeel et al., 2015) components and their variability during resting states for reach, grasp and grasped movement tasks performed using a human arm. In this study, we employed a novel protocol to understand the reconstruction mechanisms concerning a simple movement by recording electroencephalography (EEG) signals during the execution of hand movements in healthy subjects. The data acquisition was done for 30 healthy participants performing four different motor tasks consist of reaching the target, grasping the target, lifting the object upwards, and moving the object towards left or right directions (Bodda et al., 2016; Diwakar et al., 2014). Rhythmic activity was analysed during the premovement (alert task) condition and compared it to grasped movement tasks while the arm is moved to the left or right directions. Among movement related cortical potentials (MRCPs), a short positive to negative deflection that started -0.5ms, seen as mini wave before the onset of movement cue can be used as a potential biomarker to differentiate movement and movement initiation. The movement related cortical potentials and oscillatory changes (Pfurtscheller et al., 1998, 2009) were compared among the task conditions and we observed a rebound increment of 14% of beta oscillations and 26% gamma oscillations in the central regions could be a biomarker to distinguish “premovement”/ “relax” task and grasped movement task. The change from initiation to grasp has decreased 10% for beta oscillations and 13% for gamma oscillations, and there is rebound increment 4% beta and 3% gamma from grasp to grasped movement. The χ^2 - test indicated the percentage of brain oscillations varied among premovement, left movement and right movement tasks rejecting the presumed null hypothesis and were statistically significant ($p=0.003$). Among genders, with χ^2 statistic as 89.43 (degree of freedom =8), $p < 0.0001$). This work also explored investigating the combination MRCPs and spectral estimates of α, β, and gamma oscillations as features using machine learning classifiers to categorize movement data and have attained 70% accuracy rate with support vector machines polynomial kernel. In this work, to decode grasped movement in the context of BCI applications, our study has shown potential biomarkers that can be used for distinguishing pre-movement and movement tasks using both temporal and spectral characteristics.

Acknowledgment:
This work derives direction and ideas from the Chancellor of Amrita Vishwa Vidyapeetham, Sri Mata Amritanandamayi Devi. This study was partially supported by the Department of Science and Technology Grant DST/CSRI/2017/31, Government of India and by Embracing the World research for a cause Initiative

Keywords:
Human grasped movement; electroencephalography; readiness potentials; machine learning; cortical potentials.

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Trait mindfulness is associated with shorter temporal horizons, but not lower delay discounting

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Introduction:
Theories of impulsivity (especially delay discounting) and mindfulness emphasize an orientation towards the present (Murphy & MacKillop, 2012). However, impulsivity may be a result of a hedonistic orientation towards the present moment, while in mindfulness emphasis is laid on attention towards the present and non-reactivity to reactions (Murphy & MacKillop, 2012). Despite the theoretical link between time perception, mindfulness and impulsivity, these three factors have not been studied simultaneously.
Impulsivity has been operationalized using multiple measures such as self-report questionnaires, response inhibition tasks (motor impulsivity), and delay discounting tasks. Delay discounting, especially monetary delay discounting is strongly correlated with self-report measures, and behaviours associated with impulsivity. Monetary delay discounting is fairly stable over many months and has thus been called a trait variable making it a good proxy for studying impulsive decision making. As per the "Perceived time-based model of Intertemporal decision making" (Kim and Zauberman, 2009) - Psychological distance (temporal distance) of the delay influences how a reward is discounted at that delay.

Some studies have found different influences of trait mindfulness and trait impulsivity on temporal discrimination, estimation, and reproduction tasks (Weiner et al., 2016; Wittmann et al., 2014) These tasks measured time perception in the order of seconds. How such orientation towards the present influences time perception for longer delays has not been well studied. This question was at the core of this study.

Method:
The experiment was conducted online and hosted on psytoolkit[dot]org. Data was collected from fifty-six volunteers. The study consisted of three tasks: Delay discounting, Trait mindfulness and Temporal distance. Delay Discounting was measured using the Kirby's Monetary choice Questionnaire (27 Questions) (Kirby et al., 1999) using currencies based on INR generated using Purchasing Power Parity. Trait Mindfulness was measured using the Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2006). Temporal distance was measured by asking participants to rate "How far does a day x day from now feel?" On a scale of 1 (Very Near) to 99 (very far). 21 unique delays (same delays as in Kirby's MCQ) were presented to the participants in random order.

Analysis:
Five participants were excluded for answering the same option for all questions in either Kirby's MCQ, or Temporal distance task. For delay discounting, discount factor k was calculated for each participant using the method described in Kirby and colleagues (Kirby et al., 1999). Total FFMQ score was calculated for each participant using the scoring rules. For Temporal Distance, responses of participants were modelled using the following equation:
$T = a*t^b$ where T is the subjective temporal distance, t is the delay, or time in days, 'a' and 'b' are parameters. 'a' captures the overall level of time contraction, and 'b' captures the degree of nonlinearity (diminishing sensitivity to time) (Kim & Zauberman, 2009). In their study, Kim and Zauberman (2009) found 'a' was positively correlated with discount factor, while 'b' was negatively correlated with discount factor. 'a' can take any positive value, while 'b' can take any value between 0 and 1. Parameters 'a' and 'b' were calculated for each participant. Normality was checked using the Shapiro-Wilk test. Given that the discount factor k was not normal, Spearman rank correlation was performed on measures of Delay discounting, FFMQ, and temporal distance.

Results:
Significant correlation was observed between Total FFMQ and coefficient 'a' ($r = -.346$, $p < 0.05$). The correlations between discount factor 'k' and measures of mindfulness or temporal distance were not significant.

Discussion:
Total FFMQ score was significantly negatively correlated with temporal distance parameter 'a'. The negative correlation shows that the future appears subjectively closer with increase in trait mindfulness. Trait mindfulness and the practise of mindfulness has been observed to influence time perception in the order of seconds and minutes. Subjective time is expanded for those high on trait mindfulness. This study contributes to the time perception literature by showing how trait mindfulness influences time perception in the order of days. Subjective experience of time expands in seconds and minutes, but in the order of days, the future appears closer. The data did not support the prediction of the perceived time-based model of intertemporal choice (Kim & Zauberman, 2009) as no significant relationship was seen between discount factor k and measures of temporal distance. Further studies are needed on other measures of impulsivity or discounting and temporal distance over multiple time scales.

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Multiple Object Awareness capacity is larger and correlates with Visual Working Memory capacity

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Introduction:
The capacity of our awareness has been hotly debated in the literature (Cohen, 2019). Our visual working memory capacity measured through a change detection task indicates limitations (Vogel & Machizawa, 2014). In a recent study (Wu & Wolfe, 2018) have argued that capacity limitations measured using multiple object tracking (MOT), which is usually around 3 or 4 underestimates our knowledge. They used a modified MOT paradigm and showed using a different measure called multiple object awareness (MOA) capacity measure that standard score obtained from MOT underestimates our knowledge. They argued that our location knowledge or awareness is based on graded probabilistic representations. Our first objective was to replicate the findings indicating that MOA scores are consistently larger than MIT scores. Our second aim was to see whether MOA scores would also be consistently larger than capacity scores obtained using other tasks in which objects per se are not moving. We hypothesized that MOA scores would be larger than the VWM score obtained from the change detection task. Finally, we checked whether those with lesser scores in one measure would also have lesser scores in the other measures.

Methods:
Forty volunteers participated in the study. Visual working memory capacity was measured using a change detection task (Vogel & Machizawa, 2004). The task consisted of an initiated stimulus with eight color squares (four on each side) presented briefly for 100ms and a test array presented after a 900ms retention interval. Participants were cued to the side in which change may occur. A color square changed in half the trials and there was no change in the other half of the trials. The experiment had a total of 210 trials. Capacity K = S x (H – F) where K is the memory capacity, S is the size of the array, H is the observed hit rate and F is the false alarm rate. Multiple object awareness capacity was measured using a multiple object tracking task designed by Wu and Wolfe (2018). In this task, the display consists of shapes of 16 animals move randomly without collision. The task was to identify the location of the specified animal once the animals stop moving and they are replaced by gray discs. Observers were asked to click on location by location until they find the correct location for the specified animal. The number of clicks required to find the correct animal picture is obtained to calculate MOA capacity. Multiple identity tracking (MIT) scores were calculated by discarding responses that used more than one click.

Results:
The VWM capacity across participants ranged between 1.4 to 4.8. The range of the MOA capacity was 4.3 to 10.8 and for MIT scores was 1.9 to 5.1. All the scores were checked for normality using the ShapiroWilk test. Consistent and replicating the earlier study, MOA scores were more than MIT scores indicating that the classic MIT capacity underestimate location knowledge. A paired samples t-test showed that the difference between MOA capacity and MIT scores were significantly different, $t(39) = 26.83$, $p < .001$, $d = 4.27$. The difference between VWM capacity and MOA scores was also significantly different, $t(39) = 21.22$, $p < .001$, $d = 3.36$. The difference between VWM capacity and MIT scores was also significantly different, $t(39) = 3.22$, $p = .003$, $d = 0.51$. The correlation between VWM capacity and MOA capacity was significant, $r = 0.67$, $r^2 = 0.45$, $p < .001$. The correlation between VWM capacity and MIT score was significant, $r = 0.57$, $r^2 = 0.45$, $p < .001$. Finally, the correlation between MOA capacity and MIT score was significant, $r = 0.87$, $r^2 = 0.77$, $p < .001$.

Discussion:

We were able to replicate the findings the earlier study showing that MOA scores are greater than MIT scores (Wu & Wolfe, 2018). As before, MOA scores were roughly two times more than MIT scores. In addition, the MOA scores were also higher than the VWM capacity score measured using a change detection task indicating that the effect is possibly generalizable to other measures of visual working memory capacity. The different scores were highly correlated. The significant correlations indicate that those whose capacity is deemed better using one of the measures used in the study are better with other measures indicating that these measures are reliable and consistent. Further studies need to consider other aspects of conscious awareness and whether the information that we are conscious of is underestimated as well.

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Modeling joint torque estimations for a lower and upper limb based on accelerometer derived gait data for assistive exoskeleton

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Human movement analysis instrumentation consists of sensor-based measurement techniques designed to objectively characterize and statistically analyze a person's motor functions and skills. The kinematic and kinetic properties of human movements can be determined using movement analysis instrumentation, and musculoskeletal functions can be statistically analyzed. Gait analysis can be used as an analytical method to better understand musculoskeletal functions, kinetic and kinematic parameters of various gait phases that are linked to a variety of neurodegenerative disorders. The goal of this study is to model required joint torques and forces during anticipation, preparation and execution of foot movements using sensors that can maintain dynamic posture and coordination during movement The joint torques can be approximated using an inverse dynamics approach, and it has been claimed that joint torques and forces can act as a biomarker that can differentiate the locomotion. Gait kinematic analysis was performed using tri-axial mobile phone accelerometers, attached to Brachium of arm, Antecubitis, Carpus, Coxal, Femur, and Tarsus. The data collection and methods were approved by the institutional ethical review board and an open consent was collected from the participants prior to gait recordings. The subjects were selected with no gait pathological disorders. A total of healthy volunteer's n=40, mean age=18-30, mass=74.7 ± 4.1 kg, height=171.5 ± 9.2 and body mass index: 22.6±2kg/m² were recruited. Each individual was instructed to complete two trials, each containing three cycles per trail with a sample rate of 128 Hz. The torque and force acting on the upper and lower trunk joints were calculated using joint kinematics and inverse dynamic approaches during anticipation, preparation and execution. The joint torque joint combinations throughout the stance and in progressive gait, offer a novel biomarker for each increased during flexion of Coxal (251±54Nm to 317±53Nm) and Femur flexion (114±30 to 123±22Nm) in the early initiation and preparation of walking is adversely associated with body size. The identified postural modifications, according to our model, are adequate to counteract the size-related increase in the knee moment and minimize the rise in the hip moment. The torque amplitude and variations among different joint based on the individual's height and weight. The capacity to expand gait-based reconstruction of human walking by translating joint-kinematic data classification and performing torque analysis in real-time can enable future prosthetic devices, according to our findings.

Keywords: GAIT, joint torque, low-cost wearable sensors, exoskeleton.

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A scale-invariant perturbative approach to study information communication in dynamic brain networks

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Introduction:
Communication between neuronal entities at multiple scales of the brain underlies virtually all aspects of how we perceive and understand the world around us [Avena-Koenigsberger et al., 2018]. This communication is primarily a product of how the brain's structural network interacts with the dynamics that evolves over it, and plays an important role in linking structure with function. Moreover, the interaction of dynamics with the network defines the true importance of a region in the network, dictating its impact on dynamical processes that unfold over it. Probing network-dynamical interactions is undoubtedly a rich problem, considering the great diversity in dynamical forms that depend on the scale of interest (micro to macro), pathological state etc. and associated structural networks. Prior methods of obtaining insights such as tracing communication in silico or data driven approaches pose challenges ranging from inadequate models to lack of mechanistic insights afforded by them. There is thus the need for methods which are not only general, simple, and insightful of communication of information, but also easily extendable into an experimental or clinical setting for validation and design of therapeutic interventions. Here, we identify the potential of a methodology established in the network science domain in offering insights into the roles played by different regions in a brain network in the transfer of information, and subsequently communication. As a simple platform to test this method, we employ in silico neurodynamical models running on empirically derived whole-brain structural connectomes. We perturb a region of interest by changing its activity, and then observe the changes it brings out in the rest of the network. This helps define the influence exerted by the region. The implementation of a functional lesion, whereby we freeze the activity of a region, making it "blind" to perturbations, helps in singling out the role of the region in arbitrary communication processes. We further apply this methodology at the level of large-scale resting state networks (RSNs), to look at whether RSNs can have unequal centralities in communication.

Methods:
Perturbation protocol and associated metrics We implement a perturbation protocol as in [Harush and Barzel, 2017] on whole brain neurodynamical models evolving on empirically derived structural connectomes. Once initialised, we let the system reach its steady state. A single region is then chosen and its activity is set at a perturbed value. This results in the rest of the system stabilising at a new "perturbed" steady state. The change in the activity of a region per unit perturbation is its steady-state response. Repeating this exercise over each region in the network helps populate the linear response matrix, R. The "Net influence" quantifies response asymmetries, and is given by the difference between the column and row sums of R. To study the effect of a region i on the response of region m elicited by the perturbation of region n requires carrying out the procedure mentioned above, but now with the activity of i fixed at its unperturbed steady state value: a "functional lesion". This generates a new response matrix $R^{\{i\}}$, which has no contribution of i on the transfer of information. The difference between $R^{\{i\}}$ and R is captured by the measure "Flow" and denotes i's role in information transfer.

Datasets:
Cam-CAN
The SC and rs-FC (for model parameter estimation) was derived from empirical Diffusion Weighted Imaging data of 40 healthy participants (19 males; 21 females, age range 18-38), from the Cambridge Centre for Ageing and Neuroscience [Shafto et al., 2014, Taylor et al., 2017], as used in [Naskar et al., 2021].

NKI
DTI based SC and rs-FC/Pearson correlation matrix of 171 healthy participants (99 males and 72 females, age range 4-85) were obtained from the Nathan Kline Institute (NKI)/Rockland sample as made available in the UCLA Multimodal Connectivity Database [Brown et al., 2012].
Simulation

We use two models as a platform to showcase this method: Mean Field Model [Deco et al., 2013] and Linear stochastic model [Galán, 2008]. The models evolve on the SC for 315.2s, and the BOLD derived rs-FC is compared to the empirical rs-FC, to arrive at model best fit parameters. The perturbation protocol involved an initial 60s noiseless evolution to steady state, followed by a 5s perturbation, to arrive at the new steady state.

Results:
The perturbation protocol unearths clear asymmetries in dynamical influence capabilities which manifests as an organisation of brain regions as "influencers" (Positive net influence) and "followers" (negative net influence) along the core-periphery axis. The peripheral nodes are predominantly strong followers, whereas the core comprises influencers. The overall extent of asymmetry is maximum for the model that is closest to the empirical ground-truth. As the model parameter moves away from the empirical match, we observe a loss of this influencer-follower hierarchy. The functional lesion step clearly shows that the nodes with intermediate strength (as opposed to the core or periphery) are central in mediating information flow. Application of the functional lesion at the level of large-scale Resting State Networks shows that the regions in the Salience Network have the highest level of flow, pointing to its role as a mediator in communication processes between other subnetworks. The Linear Stochastic Model implementation shows a periphery dominated flow structure in contrast to that of the Mean Field Model, emphasising the role of dynamics in communication processes, and simultaneously showcasing the generality of this method.

Conclusion:
This work presents a simple scale-invariant perturbative formalism that can both probe the distributions of influential nodes in the network, as well as identify nodes that are central to communication processes, both of which have immense experimental and clinical importance in neuroscience. The robust theoretical framework surrounding the formalism additionally opens up possibilities of mathematically studying the communication patterns permitted by established neurodynamical models. Most importantly, the formalism is invariant to the form of the underlying dynamics and instead gathers insights purely based on the response of a perturbed system of neuronal entities, making it ideal for implementation with minimal assumptions about how the system functions.

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Aperiodic and periodic components of ongoing oscillatory brain dynamics link distinct functional aspects of cognition across adult lifespan

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Introduction:
The functional relevance of electrophysiological oscillations in aging neuroscience has been widely known (Clark et al., 2004, McEvoy et al., 2001). Signal transmission in the brain propagates via distinct oscillatory frequency bands but the aperiodic component - 1/f activity - almost always co-exists, which most of the previous studies have not sufficiently taken into consideration. With aging, this communication mediated by different frequency bands is hindered by noise, which arises from the increased baseline neural activity (Hong et al., 2012). This increase in noise is often linked to impaired cognition by few studies (Voytek et al., 2015, 2020, T Y Swaab et al., 2018). In spite of this evidence, it is still unclear what aspects of neural communications mediated by oscillatory frequency band and non-oscillatory background noise links to what cognitive and metacognitive aspects over the lifespan. We used a recently proposed parameterisation model that delimits the oscillatory and aperiodic components of neural dynamics on lifespan ageing data using Magnetoencephalography (MEG). Since, healthy ageing underlines an enormous change in local tissue properties, any systematic relationship of 1/f activity would highlight their impact on the self-organized critical functional states. Furthermore, we have used patterns of correlation between aperiodic background and metrics of behaviour, to understand the domain general effects of 1/f activity.

Methods:
Datasets: Resting-state MEG and VSTM data used for this study were obtained from The Cambridge Centre for Ageing and Neuroscience (Cam-CAN) which is a large scale, multimodal, cross-sectional adult life-span (18-88) population-based study (Taylor et al., 2007, Shafto et al., 2014). MEG data was collected for 8 mins and 40 sec (eyes closed). 280 participants were further divided into 4 age groups for categorical analysis: Young Adults (18-35), Middle Elderly (36-50), Middle-Late (51-65), Older Adults (66-88). To capture normative brain patterns over lifespan we carried out a continuous analysis and divided the cohort into bins of 5 years. The VSTM task design was adapted from Zhang et al., 2008. On each trial, 1, 2, 3, or 4 coloured discs were presented for 250 ms, followed by a Blank screen for 900ms. One of the original locations was highlighted and a response colour wheel was presented. Participants had to report the remembered hue of the highlighted disc. Each trial was followed by an 830 ms fixation period. The following measures were estimated (2 blocks of 112 trials):
1. Precision (deg)

2. K-score

3. Metacognitive awareness (deg)

4. Reaction Time (ms)

Analysis:
Power Spectral Density was calculated using Welch's periodogram method on ICA corrected MEG time series. Using a parametrization model, we extracted periodic (CF, PW, BW) and aperiodic features (Slope, Offset). Oscillations were post hoc grouped into theta (4-8), alpha (8-12) and beta (13-30) frequency bands. Further, we estimated band ratio measures of all periodic components for each frequency band. The statistical method includes linear and nonlinear regression, Pearson's linear correlation and Spearman's rank correlation. To establish statistical significance across two independent variables, age categories and frequency bands we carried out t-test or Wilcoxon rank-sum test respectively.

Results:

Our results show significant global increase in 1/f aperiodic slope (R^2 = 0.684, p = 0.0003) and decrease in 1/f aperiodic offset (R^2 = 0.31, p = 0.03) associated with age, which concurs with the age associated neural noise hypothesis. Aperiodic features were found to not only vary across subjects (more for elderly) but also across different sensors indicating substantial variability and idiosyncrasy. After regressing out age, 1/f slope was found to be predictive of all cognitive measures including the metacognitive awareness (***RT***, R^2 = 0.46, p = 0.01; ***K***, R^2= 0.7, p = 0.0003; ***d***, R^2 = 0.33, p = 0.03; Precision, R^2= 0.75, p = 0.00005). We computed oscillatory features after removing the 1/f noise and found that alpha power to linearly decrease with age (R^2 = 0.75, p = 0.00005) which was mainly contributed by occipital sensors, whereas theta (R^2 = 0.36, p = 0.02) and beta (R^2 = 0.70, p = 0.0001) band power increases with age. Interestingly, alpha CF declines (R^2 = 0.4, p = 0.02) globally (except centro-parietal sensors) whereas beta CF increases (R^2 = 0.46, p = 0.007) with age. Linear regression was also performed considering each VSTM task and functional measures as the response and explanatory variable respectively.

Resting-state alpha CF and θ/α band power ratio were found to be predictive of the processing speed (RT) (R^2 = 0.43, p = 0.01). Parietal theta Power and θ/α power ratio well predicted the VSTM capacity (R^2 = 0.53, p = 0.004, R^2 = 0.42, p = 0.008) and alpha power well predicted the Precision (R^2 = 0.43, p = 0.01).

Conclusion:

Our results suggest that age-associated global change in 1/f baseline, alters the functional critical states of the brain affecting the global information processing impacting critically all aspects of cognition e.g., metacognitive awareness, speed of retrieval of memory, cognitive load and accuracy of recall through adult lifespan. This alteration in 1/f crucially impacts the oscillatory features peak frequency and band power ratio, which relates to more local processing and selective functional aspects of cognitive processing during the VSTM task. Specifically, we find that an increase in slope with age affects speed of information processing, cognitive capacity, precision and metacognitive awareness (all behavioural measures used in this study). In contrast, oscillatory features of different frequency bands which are crucially impacted by the baseline shift in the global noisy background relates to more local processing and selective behavioural measures in VSTM task. In summary, this study leveraging on big lifespan data for the first time tracks the cross-sectional lifespan associated periodic and aperiodic dynamical changes in the resting state to demonstrate how normative patterns of 1/f activity, peak frequency and band ratio measures provide distinct functional insights about the cognitive decline through adult lifespan.

Neurocognitive dysfunction in patients with opioid dependence: Does it improve on buprenorphine-based agonist treatment?

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Background:
Worldwide opioid dependence contributes substantially to the global burden of disease disability, and mortality. Buprenorphine (with or without naloxone) is a standard treatment opioid dependence [1]. Opioid dependence is associated with impairments in several cognitive domains that include psychomotor speed, cognitive impulsivity, executive function, working memory, verbal, and visual memory [2]. Patients on treatment for opioid dependence with buprenorphine perform worse than healthy controls in memory, vigilance, attention, cognitive flexibility, and psychomotor speed [3-4]. However, cross-sectional studies fail to answer whether cognitive functions improve while patients receive treatment. To find an answer to this question, we conducted a six-month prospective study of neurocognitive function in patients with opioid dependence, started on buprenorphine naloxone. Our objectives were to determine (a) between-group differences in cognitive functions of opioid dependence and healthy controls and (b) with-in group change in cognitive functions in patients on buprenorphine.
Methods:
We recruited 63 patients with opioid dependence (OD), initiated on the buprenorphine-naloxone (BNX). We selected patients of both sex and the age range 18-55 years. We excluded patients with other substance use, human immunodeficiency virus (HIV) infection, head injury, epilepsy, schizophrenia spectrum, and major affective disorders. These comorbidities may influence cognitive function. We also recruited 50 age and sex-matched healthy controls (HC) who were not using drugs, alcohol, or tobacco. Each patient completed neurocognitive assessments at two time points: baseline and at 6 months (± two weeks) of BNX treatment. The baseline assessment was done after at least 7 (± 3) days of initiation of BNX and abstinence from the illicit opioids. We administered the following cognitive tests: Standard Progressive Matrices (SPM): for fluid intelligence that comprises inductive and deductive reasoning and is unlikely to be affected by the years of formal education; Wisconsin Card Sorting Test (WCST): for working memory, executive function, and cognitive flexibility. Total errors and perseverative errors are markers of cognitive flexibility, whereas non-perseverative error measures attention. Executive function and abstract reasoning are assessed by the conceptual level response; Iowa Gambling Task (IGT): for decision-making, impulsivity, and risk-taking behavior. We used two parameters from the IGT: the net score and the total money earned; Trail Making Tests (TMT): we applied both the TMT-A and TMT-B. TMTs assess attention, psychomotor speed, and flexibility. The 'time taken to complete' was used for our study; N-Back Test (NBT): for verbal and visual working memory, respectively. Between-group comparison was performed by the multivariate general linear model (GLM) with age and years of education as covariates. We conducted Hochberg GT2 false discovery rate correction. We analysed the with-in group change in cognitive functions by GLM, repeated measures.

Results:
The mean age of patients with OD was 30 ± 9 years. Although the age did not differ between the OD and HC, HC had higher years of education than the OD. More than half of the patients were heroin users (55.6%), the rest were using natural (28.6%) and pharmaceutical opioids (15.8%). The OD performed significantly worse than HC in most of the cognitive tests, i.e., SPM (OD 90.1 ± 9.7 vs. HC 93.1 ± 14.1, P<.0001), all parameters of WCST (Total correct: OD 32.8 ± 11 vs. HC 38.5 ± 10.7, P<.0001; Total error: OD 31.3 ± 11.1 vs. HC 25.3 ± 10.9, P<.0001; Perseverative errors: OD 16.4 ± 9.5 vs. HC 15.1 ± 9.2, P<.01; Non perseverative errors: OD 14.9 ± 9.8 vs. HC 11 ± 7.8, P<.05; Conceptual level responses: OD 23.1 ± 14.6 vs. HC 30.3 ± 14.5, P<.0001), IGT (Net total score: OD -6.83 ± 18.6 vs. HC -1.9 ± 16.9, P<.05; Total money earned: OD -1297.5 ± 964.1 vs. HC -1214.2 ± 749.5, P<.05), TMT-A (OD 51.8 ± 19.5 vs. HC 48.9 ± 20.1, P<.01) and TMT-B (OD 103.8 ± 108.6 vs. HC 92.9 ± 47.4, P<.01). The OD group also committed higher errors in verbal working memory 2-back (OD 2.76

± 1.7 vs. HC 2.34 ± 2.1, P<.01), and visual working memory 2-back (OD 6.17 ± 2.78 vs. HC 5.44 ± 2.92, P<.05) tests. With-in group analysis showed significantly higher total correct (T0 32.8 ±11 vs. T1 38.9 ± 9.4, P<.0001) and conceptual level responses (T0 23.1 ± 14.6 vs. T1 31.5 ± 12.6, P<.0001) and lesser non-perseverative error (T0 14.9 ± 9.8 vs. T1 11.3 ± 6.9, P<.01) in the WCST after six-months of BNX treatment. The time taken to complete TMT-A (T0 51.8 ± 19.5 vs. T1 42.3 ± 19, P<.001) and omission error in the verbal working memory 2-back test (T0 2.3 ± 1.4 vs. T1 1.8 ± 1.1, P<.05) were also reduced significantly in the follow-up. We observed an improved performance following BNX treatment in all the measured parameters of other neurocognitive tests. However, the with-in group difference did not reach statistical significance.

Discussion:

Patients with opioid dependence showed a wide-spread cognitive impairment in domains of global intelligence, executive function, verbal and visual working memory, decision making, cognitive impulsivity, attention, and psychomotor speed. These impairments are not explained by age and cognitive reserve (measured by "proxy" years of education). Six-month treatment with BNX was associated with an improvement in the executive function, attention, psychomotor speed, and verbal working memory. Our findings dispelled the fear of BNX related cognitive dysfunctions because we observed improvement in all other cognitive parameters (albeit non-significantly). These positive changes in the neurocognitive functions among patients on buprenorphine-naloxone might also be reflected in the improvement of day-to-day functioning and better treatment outcome.

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Measuring the Level of Consciousness in the Brain using Network Connectivity Approaches

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Identification of different conscious states such as awake, sleep, anesthesia, coma, vegetative, locked-in-syndrome, etc. in humans is extremely important from the clinical viewpoint. Often, first person reports from patients in such conditions are either impossible to obtain or unreliable. The most dangerous of scenarios may lead to a fully aware person being diagnosed as unconscious and subjected to painful clinical procedures for the reason that the person was unable to respond. Thus, there is a growing interest and need for developing theoretically formulated and empirically verified measures of the 'level of consciousness' in the brain. In addition to clinical examinations, such measures are also required for a study and understanding of the nature of 'Consciousness'. Quantitative characterization of active connections in neuronal systems in different conscious states has been established as a promising means to distinguish these states and also to measure the level of consciousness in them (see [1] and references therein). While some studies look at connectivity between specific brain regions known to be involved in conscious activity, others look at connectivity in the whole brain network. In general, connectivity between different regions is estimated by applying mathematical measures/models to temporal activity recorded from these regions. This activity may be recorded using any suitable neuronal signal acquisition modality such as electroencephalography, functional magnetic resonance imaging, magnetoencephalography, electrocorticography.

Measures based on 'complexity theories of consciousness' study connectivity in the whole network. In simple terms, they are based on the idea that conscious states are both 'integrated' and 'differentiated' as each conscious experience is perceived as a whole and each conscious scene is different from any other scene [1, 2]. These have recently become quite popular, especially because they are backed by theory and tested on simulations. Within this domain of complexity theories of consciousness, we propose and test different approaches for measuring connectivity between different brain regions and then quantify the consciousness level using a variety of measures on the obtained network structure. The approaches used for measuring connectivity include both functional connectivity, i.e. linear correlation and directed (or causal) connectivity, i.e., Granger Causality [3] and Compression-Complexity Causality [4]. The latter two are mathematically well formulated causal inference techniques that are applied to time series data and can help to determine network structure based on the amount and direction of information flow or causal influence between considered nodes in a network. The level of consciousness is then quantified using graph-theoretical, topological and statistical features of the obtained network. We first test these techniques on some simulated networks (with various topologies) and then apply them to electrocorticographic recordings taken during awake, anesthesia and sleep states in four macaques, collected in a study by Yanagawa et al. [5], to distinguish the different levels of consciousness in these states. These recordings were acquired (by authors of [5]) using the multi-dimensional recording technique and hence have high temporal and spatial resolution, making them suitable to construct reliable network structure. In one of our previous works [6], we have applied a novel 'Network Causal Activity' measure based on Compression-Complexity Causality on a subset of awake and anesthesia state recordings collected in [5] to distinguish between these two states.

This study compares some existing and novel connectivity measures for quantification of different conscious states and further employs some existing and novel measures for estimating the level of consciousness in brain networks. By shedding light on the promising approaches, the study will help to guide the use of these methodologies for future research and applications in the study and measurement of consciousness.

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Direct vs Indirect injury response to neonatal brain: a study of white matter volume, Cognition and resting state network changes in Birth brachial plexus vs Traumatic brachial plexus injury.

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Background:
The human brain constantly forms new synapses and connections every day at different stages, but any injury to brain can cause an adverse effect on growth potential. Cortical and cerebral response in Neonatal brain (brain is immature and myelination is incomplete) to a direct (Traumatic brachial plexus palsy) and indirect (Birth brachial plexus palsy) injury is not well understood. Injury to the Neonatal brain may be studied with alerted white matter volume and functional connectivity in the brain. Many studies studied corpus callosum volume as a reliable marker of white matter.

Objective:
Examine the alteration in the Corpus Callosum white matter volume in paediatric cohort due to Brachial plexus injury (Indirect) & Traumatic brain injury (Direct).

Method:
Children from 1 to 18 years were recruited from NIMHANS OPD after Informed consent was obtained with the proper explanation of the study to the patient's parent/guardians in both, we performed MRI scanning on a cohort of 31 BBPI and 36 TBPI and their Cognitive assessment was done according to their age. Hofer and Frahm's segmentation were used, DTI and resting-state data were analyzed by FSL toolbox and CONN and corpus callosum volumetry groups analysis was performed.

Result:
DTI study revealed a significant difference in corpus callosum volume between the BBPI and TBPI. In I'st segment (prefrontal area) BBPI have Higher CC white matter volume than TBPI group. In segments II, III, IV and V, TBPI is having high CC white matter volume than BBPI group. The cognitive assessment showed us BBPI participants have a better social quotient than TBPI participants and TBPI participants are better in IQ, Working memory, Processing speed, Perceptual reasoning and Verbal comprehension. Resting-state data showed BBPI have 20% higher activity in sensorimotor ICA.

Conclusion:
Residual integrity of the nerve axon remains that allows damaged axons to recover and regenerate. The increased volume of CC would be the effect of the plasticity or restoration of callosal volume in the brain. BBPI patients had injury from birth, so BBPI have better adaptation in life with their injury where TBPI occur later then BBPI. It may the cause of BBPI patients have better social quotient and resting state data showed high activation in sensorimotor ICA.

Intra-individual Variability in Reaction Time: A Marker of Sex Differences in Prefrontal Cortex (PFC) Cognitive Control Tasks

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Introduction:
Intra-individual variability (IIV) in reaction time (RT) was used to delineate sex-differences in executive functions (working memory, inhibition, flexibility and decision-making) because evidence for sex-differences in prefrontal cortex (PFC)-based functions is inconclusive.

Method:
Healthy student volunteers (N=183, mean=22. 39 yrs.) performed executive control tasks (digit span task, Simon task, Tower of Hanoi, & Iowa gambling task). Transformed mean and IIV RT (SD/Mean RT) was analyzed separately for males (n=149) and females (n=34) to understand the extent of homogeneity in cognitive control.

Analysis and results:
Using mean RT indicated working memory positively correlated with inhibition ($r = .39$; $p = .02$) in female participants whereas in male participants, working memory positively correlated with decision-making ($r = .17$; $p = .04$) and inhibition positively correlated with cognitive flexibility ($r = .24$; $p = .00$) and decision-making ($r = .21$; $p = .00$). Using a measure of variability (IIV RT) showed working memory positively correlated with inhibition ($r = .63$; $p = .00$) for female participants whereas no RT on the four tasks remained uncorrelated in male participants.

Conclusion:
Reaction time variability in working memory and inhibitory control might be strongly interlinked in females; whereas reaction time for four PFC-based cognitive functions were uncorrelated in males. Intra-individual variability (IIV) in reaction time in cognitive control tasks might be a robust marker of sex differences, possibly reflecting the homogeneity and in integrity in PFC-based functions.

Acknowledgement:
The data was used from Faculty Interdisciplinary Research Grant (MI01434) and analyzed as a part of Department of Science and Technology – Cognitive Science Research Initiative Grant [DST/CSRI/2018/100(G)].

Distinct roles of MMN and P300 in processing prediction errors across modalities

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Prediction errors in the brain are indexed by two ERPs – MMN (Mismatch Negativity) and P300 which are elicited whenever there a violation of regularity in the pattern of a repetitive stimulus. MMN is considered to be elicited pre-attentively whereas, P300 being a late component is considered as a marker of attentive processing of oddballs. Even though the roles of MMN and P300 in processing oddballs/prediction errors have been studied in great detail1, their relationship to each other across various sensory modalities still remains elusive. Previous studies2 have shown that multisensory contexts speed up the early sensory N100 response but how is that mapped to the processing of prediction errors is still unknown. In this study, we aim to investigate the following questions:

1. Do multisensory benefits extend to later ERPs that represent prediction errors, i.e., MMN/P300?

2. Is there a sensory-cognitive dissociation in the source distribution of MMN and P300?

EEG was recorded from 22 healthy human volunteers (13 females) in the age group of 22-43 (mean=25.7, SD=±4.19) years during presentation of a classical oddball paradigm comprising two kinds of stimuli, i.e., standard (repetitive occurrence) and oddball (rare occurrence) where the participants had to count and report the total number of oddball stimuli in each block. All participants signed an informed consent form following the ethical guidelines and prior approval of Institutional Human Ethics Committee of National Brain Research Centre, Manesar. Post the EEG experiment, the 3D sensor coordinates and MRI scan of each participant were recorded for accurate source localization. The paradigm was tested across five modalities: unimodal audio, unimodal visual, audio-visual (bimodal), cross-modal audio and cross-modal visual. The stimuli of visual only modality consisted of a standard blue square and a rare red triangle. The auditory stimuli were inspired from musical notes, the standard as the C4 note and the oddball as the C5 note (higher octave), according to tuning of A440 pitch standard. The participants were asked to keep their eyes open and fixate on a central cross on the screen during the presentation of all auditory stimuli. The inter-stimulus interval also consisted of the same cross-fixation. The length of each oddball and standard stimulus was 350 ms and the inter-trial interval ranged between 800-1200 ms (mean=1000 ms). The bimodal and cross-modal conditions were constructed from combinations of the unimodal audio and visual stimuli. Each block had 100 trials and there were four blocks per modality, which were presented in a random order. 14% oddball stimuli were presented per modality. The MMN and P300 ERPs were obtained from the EEG data (pre-processed) by taking the grand average of trials across all participants and computing the difference between the oddball and the standard waveforms (oddball-standard).

A repeated measures ANOVA on the subject level data revealed that there was a significant effect of modality on the latency of P300 ($F(2,40)=786.509$, $p<0.0001$) and MMN ($F(2,40)=383.506$, $p<0.0001$). A comparison of amplitudes also revealed a significant effect of modality on the peak amplitudes of P300 ($F(2,40)=3.654$, $p=0.03$) and MMN ($F(2,40)=25.093$, $p<0.0001$). Post-hoc comparisons with Bonferroni-adjusted p-values indicated significant differences in the P300 and MMN latencies across modalities with the audio only modality showing the slowest MMN peak latency but the fastest P300 peak latency of all modalities. Source localization using eLORETA revealed fronto-central areas underlying the MMN response in the audio only condition; secondary visual areas along with the temporo-parietal junction elicited MMN in the visual only condition; and the audio-visual condition yielded MMN sources that were located in the multi-sensory areas STG (superior-temporal gyrus) and MTG (medial-temporal gyrus). Interestingly for all the modalities, P300 had fronto-central generators. We saw that the pre-motor and the supplementary motor areas were the common areas responsible for eliciting P300 in all modalities with the frontal-eye field seen additionally in the visual only modality.

The results of this study reveal that the processing of prediction errors become modality-independent (indexed by P300) from modality-sensitive (indexed by MMN) as the mismatch information flows up the predictive hierarchy of the brain. Fronto-central auditory MMN might be indicative of a stronger call for attention towards change in a single stimulus feature i.e., frequency change that requires an active comparison of the mismatch with the standard, as opposed to changes in color/shape in the visual oddball that easily get detected at the level of the secondary visual cortex. The audio-visual MMN was the fastest and the latency of audio-visual P300 was very close to the P300 latency of the fastest modality, i.e., audio only, suggesting that the leading modality, at various stages of ERP, temporally facilitates the lagging modality, speeding up the process of change detection for the multisensory modality.

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Locality Effects in the Processing of Argument Structure and Information Status using Reading Aloud Paradigm

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Introduction:
In this work, firstly, we created a pilot read-aloud speech corpus where two native speakers were asked to read aloud sentences in Hindi. Secondly, based on the aforementioned corpus, we tested the following theoretically motivated hypotheses and reported preliminary results. These hypotheses were investigated by incorporating various cognitively and discourse motivated word-level features viz., *word length, word frequency, integration cost (IC), storage cost (SC), information status (IS), and phrasal status (PS)* into a linear regression model aimed at predicting reading aloud word duration.
1. *Frequent words are processed faster than non-frequent words.* The Dual Route Cascaded (DRC) model of visual word recognition and recognition (Coltheart et al. 2001) proposed and validated this hypothesis for English words in isolation. Going beyond, we validated the aforementioned hypothesis for words occurring inside entire sentences in Hindi.

2. *Increased processing costs as captured by Dependency Locality Theory (Gibson 2000; DLT) lead to greater reading aloud time in Hindi.* In a recent study, Ranjan et al. (2022) validated this hypothesis, but we show DLT effects factoring in information status too in the regression model predicting reading-aloud time.

3. *Arguments (obligatory elements) are processed faster than adjuncts (optional entities).* This is because arguments are encoded by verbs which further helps in their processing ease (Tutunjian and Boland 2008). This hypothesis has been validated for several SVO languages. Our study reports an inconclusive result for Hindi, with SOV as dominant word ordering.

4. *Words at Topic position are processed faster than words at Focus position.* Prior work has shown that languages adhere to given-before-new principle by uttering salient information prior to the new content (Clark and Haviland 1977). Moreover, the givenness/topicality has been associated with predictability/accessibility effects (Arnold 2011). We tested whether the production is faster for the Topic (Given) elements compared to Focus (New) elements and disprove our original hypothesis.

Background:
In Hindi, given (Topic) information occupies the clause-initial position whereas the New (Focus) information occupies the preverbal position (Butt and King 1996). Furthermore, DLT proposes two kinds of processing costs associated with language comprehension to explain the comprehension complexity of syntactic structures: a) integration cost which is a backward-looking cost quantifying the memory load required to process a word with its previously encountered dependents at the integration site (in terms of the number of intervening words). b) storage cost, which is a forward-looking cost quantifying the amount of memory load required to store an incomplete syntactic dependency in the upcoming structure. See Figure 1 for an illustration of information status annotation and IC/SC calculation.

Data and Methods:
We developed a reading-aloud speech corpus where two native speakers were asked to read-aloud and record 153 Hindi sentences taken from Potsdam-Allahabad Eyetracking Corpus (Husain et al. 2015) displayed on a computer screen in a soundproof environment. Each sentence recording was followed by a comprehension question related to the same stimulus to ensure that participants were not just mechanically reading the sentences.

The comprehension accuracy for the participants was 95% each. Each word in the sentence was annotated using PRAAT software for word duration extraction. We manually annotated Phrasal status with three

	deepika ne (Topic)	abhay=ko ek	kahaani (Focus)	sunaayi.
SC	1	1	1	0
IC	0	0	0	8
IS	1	0	-1	0
PS	1	1	1	0

Figure 1: Illustration of *information status* and *phrasal status* annotation, and *integration/storage* cost calculation. Annotation score for Information status: Topic= +1, Focus= -1, and None= 0 and Phrasal status: Argument= +1, Adjunct = -1 and None= 0

Predictor	Coefficient	Std. Error	t-value
Intercept	**5.69**	0.0060	942.06
Word length	**0.26**	0.0072	36.13
Word frequency	**-0.31**	0.0073	-43.07
Integration cost	**0.04**	0.0064	6.18
Storage cost	**0.12**	0.0064	19.37
Phrasal status	0.003	0.0112	0.29
Information status	**0.03**	0.0163	2.02

Figure 2: Regression model on full data set (2593 data points, all significant predictors denoted by $|t|>2$)

factors i.e., argument, adjunct, and none based on their roles in the sentences and Information Status with three factors i.e., topic, focus, and none. We assigned scores for each annotation as illustrated in Figure 1. In total, we found 421 arguments, 367 adjuncts, 182 topics, and 187 focii in our corpus. The frequency of each word was obtained from the Hindi-Urdu Treebank (Bhatt et al. 2009) corpus. We re-used IC and SC values that were calculated by Husain et al. (2015) manually to ensure quality.

Experiment and Results:
Our regression results depicted in Figure 2 over the entire data-set show that the measures viz., word frequency, word length, storage cost, and integration cost are significant predictors of word duration. The negative regression coefficients of word frequency show that a higher value of word frequency leads to lower reading aloud time, thus validating our first hypothesis. Higher values of DLT-inspired costs lead to higher reading aloud times, leading to preliminary evidence for the second hypothesis. In the future, we plan to check whether processing cost is controlled by the number of intervening referents that can lead to both facilitation as well as attenuation depending on the types of the sentence (Lewis and Vasishth 2005).
However, we found inconclusive results for the third hypothesis suggesting symmetric behavior towards processing arguments and adjuncts. The mean values of reading times of head words of arguments and adjuncts phrases were 98.00ms and 97.61ms, respectively, with an insignificant difference. In a language like English with SVO word order, the verb appears in the beginning, and argument encoding facilitates the processing of subsequent arguments. In contrast, Hindi speakers use preverbal constituents (arguments and adjuncts) to predict the verb (SOV) that appears later in the sentence. Furthermore, Hindi being a flexible word-order language, the position of arguments and adjuncts can be interchanged without any alteration in the meaning of the sentence.

Finally, for the fourth hypothesis, the regression coefficient of the information status score comes out to be positive and significant (See Figure 2). This suggests that Topic words are significantly difficult to produce than Focus words; thus, disproving the original hypothesis. The mean values of reading aloud times of Topics and Focii were recorded to be 98.34ms and 94.36ms, respectively. One plausible explanation could be that due to the given-new order of words in the sentence, the processing of new (focus) information becomes faster as one can predict the upcoming information based on the given (topic) information (Vasishth et al. 2012). Nevertheless, the proposed hypotheses need to be validated with more speakers that we plan to do as a part of future work incorporating surprisal measures (Levy 2008) in our regression model.

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Musical aptitude - a better indicator of reaction time than musical training

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Introduction:
Musical aptitude is the innate ability of humans to recognize hearing patterns in sound sequences [1]. It is also defined as the ability to understand pitch, timbre and the rhythm and structure of music [2]. Studies have also found that higher musical aptitude can be found in non-musicians as well. Musical training leads to higher auditory precision and better processing of musical elements like pitch and rhythm as well as faster reaction times [7][8].
Genetic analysis reveals that several genes that promote inner ear development and cognition are also linked to musical aptitude [2][5]. Findings also suggest that pitch perception is influenced by perceptual organization and is thought to arise during the early stages of inner ear development [3][4].

Various studies have found that musical training can result in far-transfer effects, that is, improvement of various cognitive abilities [9][10]. Although this far-transfer effect is small in size, it is still significant enough to be considered of practical interest [9]. Amongst these far-transfer effects, enhanced reaction times have scarcely been studied. The Stroop task is used to assess the processing speed of the brain and can be a good indicator of reaction times. Sachs et al. demonstrated that children who were given music-based training for around 2 years, showed changes in the cognitive control network in the brain, even though there was no change in the behavioural performance on the Stroop task [11]. Travis et al., also demonstrated how reaction times are significantly lower in professional musicians as compared to amateur musicians [12]. However, both these studies had limitations. The Sachs et al experiments were done on children and not on adults, so it wasn't apparent how an already established adult brain would be affected by this experiment. Moreover, the duration of musical training was also short term, coinciding with other developmental changes in children hence limiting any generalizations to adults, especially with longer-term musical training (5+ years). Additionally, both of these papers did not investigate the effect of musical aptitude and if its effects on musical training and reaction time.

Aims/Objectives:
The aims of this study are twofold. First, we investigate group differences in musical aptitude and reaction times between participants grouped based on musical training. Secondly, we also examine the role of musical aptitude on reaction time in adults.

Methods:
Participants
A total of 59 individuals (Age M=28.6, SD=8.08, 31 males, 28 females) participated in this study. Most respondents were undergraduate and master students. People with musical training reported having training ranging from 6 months to 37 years. Informed consent was acquired from all participants prior to any data collection. The study protocol proceeded on acceptance by the ethics committee of the Coordinating Board of the Helsinki and Uusimaa Hospital District. The participants were additionally grouped into three groups namely, non-musicians, amateur and professional musicians based on years of musical training and other additional factors such as being paid to perform, hours of music practice per week, amongst others.

Measures
Musical Aptitude was measured using the Seashore Test which evaluates Pitch and Rhythm related abilities [10]. Additionally, the Stroop interference time was selected to assess reaction time
.
Analyses
Cronbach alpha was calculated to assess data reliability. Additionally, we checked the correlation among the Seashore pitch and time scores for evaluating internal consistency. In order to examine

musical training-specific group differences, Kruskal Wallis test was performed on Seashore Pitch, Time, and Stroop Interference measures. Subsequently, post hoc Dunn's test revealed specific group differences. Finally, Spearman rank correlations were calculated between years of musical training and musical aptitude and Stroop interference times.

Results:

Cronbach reliability for the Seashore test was found to be at an acceptable level of 0.81. Significant positive correlations were observed between Seashore Pitch and Time scores ($r = 0.44$, $p < .001$). There was also a significant positive correlation observed between musical training and Seashore Pitch score. Kruskal-Wallis tests revealed significant group differences for all three measures, that is, Seashore Pitch ($p = 0.007$), Time ($p = 0.01$), and Stroop Interference times ($p = 0.007$). Post-hoc analysis using Dunn's test (Table 1), revealed significant differences only between non-musicians and professional musicians. No significant differences in either musical aptitude or Stroop Interference reaction times were observed between the amateur and professional musicians. Significant positive correlations were observed between Seashore Pitch and Time scores ($r = 0.44$, $p < .001$). There were also significant positive correlations observed between musical training and Seashore Pitch scores ($r = 0.30$, $p < .05$). Negative significant correlations were also observed between Stroop interference time and Seashore Pitch ($r = -.026$, $p < .05$), Seashore Time ($r = -.026$, $p < .05$) and musical training ($r = -.29$, $p < .05$).

Table 1: Dunn's test for finding significance between the 3 groups

	Group 1 vs Group 2	Group 1 vs Group 3	Group 2 vs Group 3
Seashore Pitch	0.810152	**0.003755**	0.165584
Seashore Time	1.000000	**0.006313**	0.122518
Stroop Interference	1.000000	**0.003789**	0.106485

Discussion:

As expected, Seashore Pitch and Time measures demonstrated a significant positive correlation as is observed in individuals with high musical aptitude [10]. It is also observed from the Dunn test that although there are no significant differences between non-musicians and amateur musicians or amateur and professional musicians, there is a significant difference between non-musicians and professional musicians in terms of Pitch and Time scores and reaction times. Contrary to what Travis et al. [12] found, that professional musicians had faster reaction times than amateur musicians, we do not observe this difference. One potential explanation could be the difference in criteria chosen to group individuals as professional or amateur musicians. This further highlights the lack of standard criteria in grouping individuals which may cause misleading results. Hence, a potentially better indicator of musicality can be musical aptitude as it has genetic bases that result in performance differences in cognitive tasks. We demonstrate that high musical aptitude is associated with faster reaction times. Another important finding was that participants in our study with no musical training background, categorised as non-musicians, were also found to have high musical aptitude. This is another potential reason why we do not find significant group differences between amateur and professional musicians in musical aptitude scores or reaction times. This study highlights the importance of using musical aptitude as an indicator of musical abilities rather than years of training or other criteria as an important measure when studying individual differences, especially in the context of far-transfer effects. A limitation of the current study is that there are several musical aptitude tests, which are more nuanced and can be used in future to examine musical aptitude test-based differences on various cognitive tasks.

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Contingency of the Capture: Conscious and Unconscious?

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Any salient stimuli will capture our attention, but attention is also captured by stimuli relevant to/contingent to our current goals. E.g., a silver object tends to capture attention when you are looking for your keys. Folk and Remington found in their study (1992) that abrupt-onset cues lead to a slower reaction time for an abrupt-onset target when the target's location is cued incorrectly but does not show much effect in the case of targets defined by colour. This has been studied extensively for the last 25 years; two experiments were conducted to examine if these abrupt onset cues can capture attention in a contingent way even when the participant is not aware of their presence, i.e., when the cue is unconscious and how this capture will differ from the one caused by a conscious cue.

Abrupt onset cues of conscious (100 ms) and unconscious (16.66 ms) cue duration were used to cue the location of colour targets (experiment 1) and abrupt-onset targets (experiment 2) in a spatial-cueing task, where the task of the participant was to look for the target letter - E or H defined either by its colour or onset depending upon the experiment and report its identity by pressing the corresponding key. The reaction time and accuracy were recorded. This was followed by a visibility test to check if the cues behaved as expected, i.e., if the conscious and unconscious cues were visible or not. Data from 40 participants was collected for each experiment and cue validity effects were analysed for both the cue durations - conscious and unconscious, and both cue-type target-type combinations, i.e., abrupt-onset cues with colour targets and abrupt-onset cues with abrupt-onset targets.

Considering that contingent capture holds, we expected to see no significant cue validity effects (if not negative) for the first experiment, as there was a mismatch in cue type (abrupt-onset) and target type (colour). Similarly strong cueing effects were expected to be observed in experiment 2, as the cue and target both shared the same property - abrupt onset. However, significant cue validity effects were observed in both the experiments irrespective of any condition, i.e., faster RTs were observed for validly cued trials than the invalidly cued trials always, suggesting that attention capture by abrupt-onset cues may proceed in a stimulus-driven manner. These stimuli will always capture attention, and the capture is not contingent on current goals. Other than that, capture by unconscious cues was found to be significantly less than that by conscious cues; this can be attributed to the fact that the representation for the unconscious cue’s decays rapidly, which diminishes their strength to capture attention.

The results of the spatial cueing task point clearly in one direction - towards stimulus-driven capture, but a surprising result was found while analysing the visibility task data. Although the task results aligned perfectly with our initial expectations, a minute detail caused a big difference.

The goal of the visibility was to check if the cues behaved as expected; hence both objective and subjective measures were used together. Participants performed a forced-choice cue location identification task; significantly higher than chance level accuracy was observed for conscious cues indicating that they were indeed aware of the cues, and abysmally low accuracy for unconscious cues implied that the participants were primarily unaware of the unconscious cues. To further substantiate the results, a subjective task - a PAS (Perceptual Awareness Scale) rating immediately followed the location identification task in every trial. Here participants had to rate how clearly, they were able to see the cue on an integral scale of 1 to 5, where 1 stands for "no experience" and 5 for " a clear experience". As expected, the ratings close to 1 for unconscious cues and close to 5 for conscious cues further substantiate the claim that cues behaved as they were supposed to.

And then, there was an unexpected tiny aberration. In experiment 1 with colour targets (i.e., cue-target mismatch condition) - participants rated validly cued trials much higher than the invalidly cued trials on the PAS scale, which implies that the valid cues were subjectively more visible than the invalid cues in experiment 1. In a complete reversal of this result, in experiment 2 with abrupt-onset targets (i.e., cue-target match condition) - participants rated invalidly cued trials much higher than the validly cued

trials on the PAS scale, which implies that the invalid cues were subjectively more visible than the valid cues in experiment 2. The complete reversal observed in these results makes it clear that there is a definite relation between the subjective visibility and the cue-target match/mismatch condition.

To understand this effect, a REPRESENTATION CROSS Model of attention capture is proposed. It states that the cue strength (visibility) is dependent on the interaction of cue type with target/distractor stimuli. The representation of the cue gets strengthened if the target type is not the same as the cue, and it gets weakened if the target type is the same as the cue. This model is based on vector (cross) multiplication and is about to explain the mechanism of attention capture for both stimulus-driven and contingent capture.

Neural Correlates of Understanding Object Concept in Human Brain

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Humans come across many objects in everyday life. Despite that, they have a remarkable ability in identifying objects with great accuracy and in very little time. Though past studies have demonstrated the neural mechanism of object recognition, but many questions related to object recognition are not answered until now. The present study tries to understand the neural processing of perceptual grouping using electroencephalography (EEG) and behavioral studies. The perceptual grouping plays a very significant role in object recognition. In the proposed study, attempts have been made to understand the nature and time required by the brain for processing objects. The neural signals were recorded from 15 healthy subjects using EEG. The signals were acquired corresponding to two events i.e., structure (a line formed by random dots) and non-structure (image containing random dots). 'Structure' event help to illustrate that how the brain creates a perception for dots forming a line, also known as a perceptual grouping. It also reflects the figure-ground concept that implies to the dots forming line (structure) in midst of random dots as figure while random dots are considered as background clutter or ground. This study attempts to evaluate the first point of ERP potential divergence between the events in different areas of the brain. The first point of potential divergence is believed to illustrate the target detection by the brain. The ERP divergence for occipital region electrodes was obtained at around 60 milliseconds while it was seen at around 100 milliseconds for frontal region electrodes. Thus, the outcome of the presented study evident that the processing of perceptual grouping in the brain takes merely 60 milliseconds. Furthermore, the difference between brain response for the events was found statistically significant in amplitude. The results showed high activation in the brain for structures as compared to non-structures. The ERP components namely P200, N400, and LPC (late positive component) were found for frontal electrodes while ERP components namely P100, N200, P300, and LPC (late positive component) was found for occipital region electrodes. The ERP was also calculated for V1 region electrodes, for which the ERP components namely C100, P100, N200, P300, and LPC (late positive component) were found. The C100 wave is believed to denote the reception of information in the primary visual cortex. Thus, the occurrence of C100 wave around 60 milliseconds for V1 region electrodes shows the involvement of the primary visual cortex in perceptual grouping. The C1 wave existence also points to the feed-forward nature of information flow in the brain. This finding was also supported by the obtained ERP topographical maps, which demonstrate the flow of information from occipital to frontal region of the brain relating to perceptual grouping. Moreover, the behavioral study was conducted and the median reaction time between subjects for structure trials was found around 450 milliseconds. Also, the average of correct responses was about 92%. However, no correlation was found between ERP study and behavioral study. These findings extend a deeper insight into the existing perceptual grouping paradigm using electrophysiological and behavioral studies. The obtained results can be used as an additional marker for understanding the nature of the processing in subjects having neurological deficits during their learning trajectory.

The impact of the second wave of COVID-19 on Indian students and the mediating roles of psychological flexibility and coping strategies on this impact

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Introduction:
India was hit severely by the second wave of COVID-19 from April to June 2021, with daily cases rising exponentially and imposed mandatory lockdown. With schools and colleges closed, students were forced to deal with online schooling, social isolation, close ones getting infected, and uncertainty regarding personal goals since major exams and job offers were cancelled. Previous studies have found detrimental effects of the pandemic-imposed environment, but not many studies have been done in India, especially with a focus on students. We aimed to detect the specific environmental factors created by the pandemic that impact these students' mental health and attention capacity and understand the psychological mechanisms that exacerbate or mitigate this impact.
In this study, we looked at two mechanisms, the first being psychological flexibility: recognizing and adapting to various situational demands. In the context of COVID-19, it is one of the key resilience variables in the fights against mental health issues. The second was coping strategies, which can be categorized into two styles: approach coping, where individual attempts to handle a problem by actively taking steps towards a solution, and avoidant coping, where an individual attempts to retreat from or deny the problem.

Method:
290 students were recruited for the study via mail and snowball sampling. The study took thirty minutes, and participants were provided monetary incentives. The experiment consisted of Demographics: age, gender and intermediate or college student; COVID-19 environment variables such as length of lockdown, perceived personal space, verbal/physical fights at home and infection among family; General Health Questionnaire-12 (GHQ-12) to measure psychological distress; Patient Health Questionnaire-2 (PHQ-2) to screen for depression; COVID-19 Student Stress Questionnaire-7 (CSSQ-7) to measure stress; CompACT-8 to measure psychological flexibility; Brief COPE-28 to assess coping styles; Sustained Attention to Response Task (SART) to measure sustained attention and Stroop task to measure selective attention. The data collection started on 30 May 2021 with the last data collected on 22 June 2021.

Results:
Participants' profile
71% of the participants were male [average age=18.8], and 48% were college students. Coming to the effects of COVID-19, 30.7% were infected with the virus. Moreover, almost 90% of the participants were either themselves infected or had a close one infected with COVID-19, and 32.4% had a death of a close one, which shows how far-reaching and severe the virus was in India during the second wave. Participants gave an average rating of 3.5 out of 5 when asked how much they worried about the effect of COVID-19 on their lives. 65.5% of the participants were distressed, 37.9% were screened for depression, and 68.6% were moderate to highly stressed. These results reflect the severity of the pandemic's mental health and personal life impacts. Our sample had significantly higher GHQ scores than those seen in general population samples in India during the same period, indicating that students were impacted more within the context of the second wave than the general population.

Environmental Factors and psychological health variables
When looking at the correlational analysis, we detected six environmental factors (length of lockdown, self-getting infected, close ones getting infected, lack of personal space, increase in fights at home and COVID-19 worry) that were significantly associated with the outcome health variables (distress, depression and stress) and were used to form the COVID-19 Impact Index. This index had moderate positive correlations ($p<0.01$) with GHQ [$\rho=0.36$], CSSQ [$\rho=0.37$] and avoidant coping [$\rho=0.3$] and

negative correlations ($p<0.01$) with flexibility [$\rho=-0.31$]. Psychological Flexibility had significant negative correlations ($p<0.01$) with GHQ-12 [$\rho=-0.51$], PHQ-2 [$\rho=-0.25$] and CSSQ-7 [$\rho=-0.32$] whereas avoidant coping had significant positive correlations ($p<0.01$) with GHQ-12 [$\rho=0.54$], PHQ-2 [$\rho=0.27$] and CSSQ-7 [$\rho=0.39$]. This suggests that flexibility correlated significantly with better overall psychological health while COVID-19 Impact Index and avoidant coping correlated with worse overall health.

Cognitive health and psychological health variables

Unlike previous studies, none of the predictor variables (COVID-19 Impact Index, psychological flexibility, coping strategies) correlated with either attention measure. Within the outcome variables, sustained attention correlated negatively with stress and selective attention correlated negatively with distress and depression.

Regression analysis was done to see how well the predictor variables could predict the outcome variables. We only ran models for the outcome health variables since the attention measures did not correlate with the predictors. The final model for distress accounted for 42.5% of the variance, the final model for depression accounted for 14.4% of the variance, and the final model for stress accounted for 28% of the variance. Results show that the predictors account for a moderate portion of the variance among distress and stress. The prediction for depression was low since we used a screener questionnaire instead of the entire questionnaire.

Since GHQ-12 and CSSQ-7 correlated with COVID-19 Impact Index, we conducted mediation analysis for both relations with three parallel mediators (flexibility, avoidant and approach coping). Results showed that flexibility mediated a decrease in the effects of the index on distress while avoidant coping mediated an increase in the effects of the index on distress and stress.

Conclusion:

To summarize, this study showed the severe impact of COVID-19 on students in India. It detected factors like length of lockdown, lack of personal space, increased fights at home, infection of self and close ones, and general worry about COVID-19 as detrimental to mental health. It also showed psychological flexibility as a resilience mechanism that mitigates this detrimental impact, while avoidant coping strategies exacerbate the impact. These results support interventions and approaches that promote flexibility, like Acceptance Commitment Therapy. Knowing the specific factors of the environment that affect mental health may also contribute to the development and testing of these approaches

Procrastination and Progress-Effort Characteristic of a Task

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Procrastination is the ubiquitous behaviour of putting tasks off into the future with sub-optimal outcomes. Temporal Motivation Theory (TMT) provides a relationship between motivation (measured as utility) of tasks and task reward, delay and expectancy (or probability) of getting the reward into account. Applied in the context of procrastination, it provides an explanation for preference reversal and a rightward skew in the distribution of completion times of tasks with a deadline such as assignments in a course. The closer the deadline gets, the higher is the motivation to work on the task, an experience all too familiar to students and researchers in academia. At the individual level procrastination is a failure of self-regulation, expressed as a temporal disjunction between the present and future selves - the procrastinator engages in activities that improve the mood in the short term, leaving the future self to deal with the consequences. Procrastination has been found to be positively correlated with impulsivity (measuring individual sensitivity to delay), distractibility and negatively correlated to conscientiousness (encompassing traits such as self-discipline, achievement motivation and organization). Coming to the task itself, procrastination depends on the timing of rewards (an aspect TMT explains) and also task aversiveness - certain tasks (such as doing taxes or laundry) are intrinsically unpleasant and more prone to procrastination. In the current study, we explore the thus far neglected relationship between procrastination and the progress-effort characteristic of tasks with a deadline. Most tasks are not discrete temporal events but require sustained effort over a period of time to complete. We define 'ease' of the task as the derivative of the progress-effort curve, denoting the marginal progress in task completion on spending one unit more effort. Tasks may start out easy and get progressively harder over time (concave progress-reward curve) or vice versa (for a convex progress-reward curve). Other tasks may have a linear relationship between progress and effort.

It is plausible that apart from the total reward and time to deadline/reward, this change of ease also affects when and how much effort individuals put into the task. Keeping all other variables constant, the utility of a task is higher when the ease is higher. This is because as individuals see that rapid progress is being made on the task, the expectancy term in the TMT equation - denoting the individual's perception of being able to finish the task and get the reward - is increased. We propose a modification of the TMT equation where 'expectancy' is now an increasing function of the ease and a decreasing function of the proportion of the task yet to be completed. Using this modified measure of motivation/utility, we ran simulations of agents completing two tasks - one with a convex and the other a concave progress-effort curve. The results suggest that keeping total reward, the total effort needed to complete the task and the time to deadline constant, individuals start working earlier on the concave tasks (which start off easier and progressively get harder) as compared to convex tasks (which start off harder and then get easier). The completion times of the task also show the same trend though the effect is less pronounced. To measure overall procrastination on the task, we take the signed area under the constant effort-time curve, with positive values indicating more procrastination than an agent working on the task with constant effort throughout until the deadline. The simulation results indicate positive procrastination values for the convex task and negative values for the concave task. So, agents put off the tasks which seem hard at the outset more than they put off tasks that start off easier.

For our actual experiment (currently being piloted), students will complete an assignment for partial course credit which involves playing a number of Rock-Paper-Scissors (RPS) rounds against a rigged bot. The task is to win a certain number of rounds (say 400) against the bot, playing as many rounds as needed. The rigged bot in fact plays such that the probability of the player winning a round (denoted p) is fixed before the player makes her choice. Players will be randomly assigned one of three conditions - 'harder', 'easier' and 'same'. In the 'harder' condition, p is higher in the beginning and gradually decreases so that the bot gets harder to win against as the task goes on, resulting in a concave progress-effort curve (and vice versa for the 'easier' condition). The 'same' condition is the control where the bot difficulty does not change. The reward, expected total effort to complete the task and the time to

the deadline are matched across the three conditions leaving only the convexity of the progress-effort curve as the independent variable. Through an initial short familiarization game against the bot assigned to the participants, they get to know beforehand about the convexity or concavity of the progress-effort curve. This is necessary so that the participants have an expectation of how the bot difficulty will change in the main assignment. Our prediction according to the modified TMT equation is that the starting times, completion times and total procrastination (as measured by the signed area under the constant effort-time curve) will be lower for the 'harder' condition as compared to the 'easier' condition. We also test the validity of the Pure Procrastination Scale (PPS) in our Indian student group, which has previously been found to be correlated with real-world procrastination. The participants will be administered the PPS questionnaire either on finishing the task or post-deadline.

Evaluating the ML Models for MindBigData (IMAGENET) of the Brain Signals

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Human-machine interaction is frequently seen as a reflection of human experience; speech recognition, human activity classification, facial identification, sentiment analysis, and so on are all based on sound and sights. Interaction with machines can often exceed the capabilities of the natural human experience, because of the availability of sensors that collect data that the human body cannot. Electroencephalographic brainwaves are a good example of this. The brain has a distinct pattern of electrical activity that comes from the aggregate firing patterns of billions of individual neurons, depending on what a person is thinking, experiencing, or doing. In principle, these electrical impulses can be recognized and processed to infer a discriminative brain activity over a wide range of visual categories in an attempt to read people's minds. This capability is useful for brain-machine interaction, among other things, in addition to clinical uses. In brain-machine interface, more effective classification approaches are critical, because better performing models can read human brain activity with greater accuracy.

Our proposed research focuses on comparing and implementing several machine learning and deep learning methods in order to achieve improved classification accuracy of EEG signals. The key contribution is to extract information (features) from EEG signals in order to classify or differentiate them based on the images used to trigger brain activity. This paper shows how to classify EEG brain waves using an image classification approach. The proposed method works by representing images and classifying brain waves signals using Machine Learning and Deep Learning algorithms. The authors have used the publicly available EEG data from MindBigData (http://www.mindbigdata.com/). The version 1.04 of MindBigData "IMAGENET" of The Brain, open Database contains 70,060 brain signals of 3 seconds each, captured with the stimulus of seeing a random image (14,012 so far) from the Imagenet ILSVRC2013 train dataset and thinking about it. All the signals have been captured using commercial EEGs (not medical grade), with the Emotiv Insight headset, covering a total of 5 Brain (10/20) locations. We have used dataset Insight v1.0 EEG with Spectrogram. The data is saved in a plain text format, with one CSV file for each EEG recording associated with a single image. There are a total of 14012 CSV files which contain data of 5 channels each, this data consists of 26,850,320 data points. These 14012 files are merged into a single CSV file creating a data frame encompassing all the required features from data.

In this research, we have used Time Series Feature Extraction Library (TSFEL) for feature extraction. TSFEL is a Python library for extracting features from time series data on the statistical, temporal and spectral domains. It enables users to do exploratory feature extraction operations on time series without having to write extra program. Statistical domain refers to the mathematical characteristics such as outliers, trends, and seasonal cycles in a data. Temporal domain refers to time and spectral refers to space characteristics of the data.

The implementation of Machine Learning (ML), Deep Learning (DL) and Convolutional Neural Networks (CNN) is presented in two parts: a) Implementation of ML, DL and CNN for EEG Signals Classification and b) Implementation of CNN for Spectrogram Images. We efficiently utilized CNN to classify EEG signals generated by seeing random images. We have increased the model's performance by adjusting the number of epochs, layers, data resampling, and signal noise reduction. Hyperparameter tuning and modifications to the CNN model improved the accuracy with which author read spectrograms and anticipated the proper label.

Bagging classifier had the highest accuracy of 73.24% in this proposed approach. The experiments were performed 14 times with different algorithms and with hyper parameter tuning. The results obtained for EEG signals classification without hyperparameter tuning was 0.12 for Decision Tree and with hyperparameter tuning was 0.13. We have used LSTM architectures, our approach takes less time to train and is less expensive computationally, yet provides an accuracy of 0.71. Whereas in CNN and DNN model, it provides an accuracy of 0.69 and 0.70. Bagging with Logistic Regression provides an

accuracy of 0.15 which is very less in comparison to the Bagging Default provides an accuracy of 0.73. XG Boost obtained accuracy of 0.32. F1 scores 0.16, 0.75, 0.16, 0.19, 0.18 and 0.35 were obtained for Logistic Regression, Bagging Classifier, Bagging with Logistic Regression, Decision Tree, Decision Tree with tunning, and XG Boost respectively. Precision 0.19, 0.18, 0.18, 0.56, 0.49 and 0.42 were obtained for Logistic Regression, Bagging Classifier, Bagging with Logistic Regression, Decision Tree, Decision Tree with tunning, and XG Boost respectively. Recall scores 0.16, 0.15, 0.15, 0.13, 0.13 and 0.32 were obtained for Logistic Regression, Bagging Classifier, Bagging with Logistic Regression, Decision Tree, Decision Tree with tunning, and XG Boost respectively. The results obtained for spectrogram Image of CNN model1 without augmentation is 0.10 accuracy and with augmentation is 0.11 accuracy. Whereas in CNN Model2 without augmentation attained an accuracy of 0.74 which is quite higher than model with augmentation attained accuracy of 0.18.

Keywords:
Machine Learning, Convolutional Neural Networks, Deep Learning, EEG, Bagging XG boost, Random Forest, Naïve Bayes, Electroencephalography

Aarshananda G Krishna
Brain Art Contribution

ACCS8
POSTER
PRESENTATIONS

Modulatory Effects of Hand Presence on Temporal Judgments

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Previous studies have shown that objects are perceived and processed differently when they are in the reachable space near the hand (the peri-hand space). Although many explanations have been given for the peri-hand effects, its basic underlying mechanisms remain unknown. Reed, Grub & Steele (2006) offered attentional explanations for the peri-hand effects by suggesting that there is faster attentional orienting towards objects appearing in the peri-hand space as compared to those appearing farther away. Their conclusion was based on the findings of RT facilitation for objects presented in the peri-hand space when compared with a baseline no-hand condition. The Attentional Prioritization account of the peri-hand effect was followed by the slower Disengagement Theory, proposed by Abrams, Davoli, Du, Knapp & Paull (2008). Abrams et al., (2008) suggested slower Attentional Disengagement for objects in the peri-hand space, based on the findings of steeper search slope for items presented in the perihand space. Their subsequent experiments also found reduced Inhibition of Return (IOR) and larger Attentional Blink in the peri-hand space, suggesting slower attention switch between items presented in this space. The slowing down of attentional mechanisms was presumed to facilitate an in-depth and more detailed processing of the items presented in the peri-hand space.

Partially apart from the attentional explanations, the Modulated Visual Pathway (MVP) account of the peri-hand effect has been dominant in recent years because of its ability to explain a large variety of benefits, and costs, associated with processing specific stimulus-types in the peri-hand space (Gozli, West & Pratt, 2012). The MVP account relies on a well-known neurophysiological framework (Goodale & Humphrey, 1998), and hypothesizes that placing an object near an action-relevant effector such as hand, would bias visual processing in favour of the Magnocellular pathway, and away from the Parvocellular pathway. That is, hand presence would result in the preferential processing of visual characteristics of objects that are relevant for action, such as its size, orientation, distance from the hand etc., over other characteristics such as color or texture of its surface. Gozli et al., (2012) predicted that the processing bias would be very specific, and reflect the properties of the M and P-cells; faster processing in the M-pathway due to its relatively larger axon diameters, and thus yielding higher temporal acuity, in comparison to the cells in the P-pathway (Derrington and Lennie 1984; Livingstone and Hubel, 1988). Thus, the M-pathway makes it best suited for processing transient stimuli and detection of rapid changes.

The current study hypothesizes that if temporal acuity is enhanced in the peri-hand space, it will also affect the judgment of the temporal extent of a stimulus presented in the peri-hand space.

A duration judgment task was used to test the hypothesis that there will be enhanced precision in the temporal judgments made for stimuli presented in the peri-hand space, relative to a baseline no-hand condition. The experimental task consisted of two squares that were presented sequentially, that could differ in their Size (2.4° x 2.4°, 3.6° x 3.6°, 9° x 9° & 10.2° x 10.2°) or Border Luminance (133.5, 150, 166.5 & 183 cd/m^2). The presentation duration of stimulus pair could be 80/100, 130/162.5, 180/225 or 230/287.5ms; all conforming to the shorter/the longer ratio of 1/1.25. Among each pair of squares, a small square appearing for short duration, and a relatively big square appearing for long duration, constituted a congruent condition. On the other hand, a big square appearing for short duration, and a relatively small square appearing for longer duration, constituted an incongruent condition. A similar congruence/incongruence condition existed for squares that differed in its border luminance (dark or bright) with respect to its presentation duration (short or long). Irrespective of the congruence conditions, participants were required to make judgements of which of the squares lasted longer (or shorter) in duration when they were presented near or far from the hands.

9 Male and 6 Female participants (Mean age = 21.8 years) volunteered for this study.

A 2 x 2 RM ANOVA was performed on the duration judgement errors committed for stimuli presented near the hands, and compared with the errors committed in a baseline no-hand condition; with Congruence (Congruent and Incongruent) and Hand conditions (Hand-near and No-hand) as the within-subject factors, for both the stimulus types of Size and Luminance. The results showed a significant main effect of Congruence for both Size [F (1, 14) =9.07, P=0.009, ηp^2 = 0.39] and Luminance [F (1, 14) =5.74, P=0.03, ηp^2 = 0.29] stimulus types. (Figures 1 & 2, respectively).

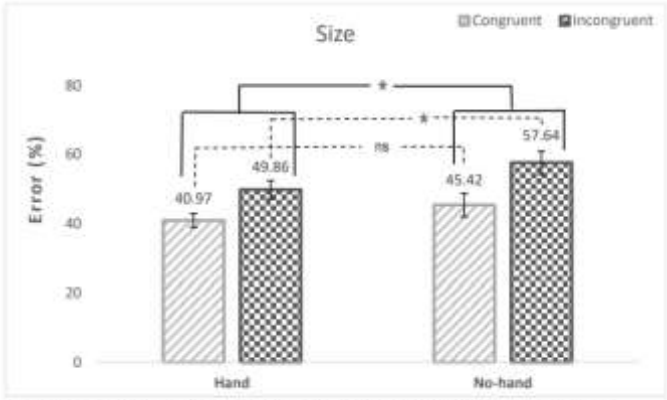

Fig 1: Error rates for Size stimulus type for the Hand and No-hand conditions

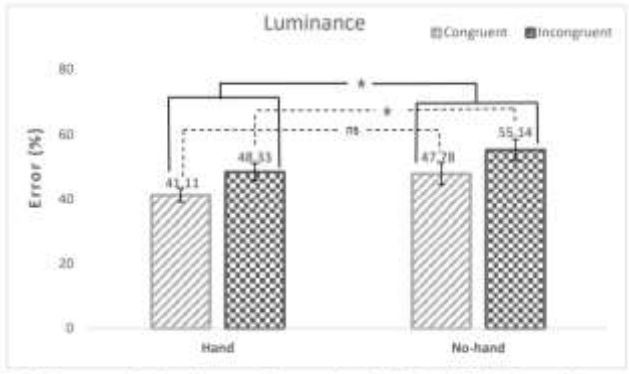

Fig 2: Error rates for Luminance stimulus type for the Hand and No-hand conditions.

Overall, fewer errors were made in the Congruent condition relative to the Incongruent condition for both Size (43% & 54%, respectively) and Luminance (44% & 52%, respectively) stimulus types. More importantly, a significant main effect was obtained for Hand conditions for both Size [F (1, 14) =6.62, P=0.02, ηp^2=0.32] and Luminance [F (1, 14) =6.45, P=0.02, ηp^2=0.32] stimulus types. The errors committed while making temporal judgements were relatively less for stimuli presented near the hands (45% and 44%, for Size and Luminance stimulus types, respectively), compared to the No-hand condition (52% and 51%, for Size and Luminance stimulus types, respectively). However, no significant interaction was found between Congruence and Hand conditions for both size (p = .42) and luminance (p = .96) stimulus types. The current findings imply higher precision in making the temporal judgments for information presented in the peri-hand space. Hand presence seem to enhance sensitivity to changes in the temporal characteristics of stimuli, and is in line with previous studies that have shown enhanced temporal acuity in processing information presented in the peri-hand space. The current finding bolsters the possibility of hand-related effects to extend beyond perception and attention, to other cognitive domains such as time perception. The present work attempts to motivate future research to make connections between the subjective experience of time and other perceptuo-cognitive processes, with the hope of stimulating cross-disciplinary empirical work and theoretical integration.

Effect of hydroalcoholic extract of Centella asiatica on 3-nitropropionic acid induced Huntington like symptoms in adult zebrafish

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Background:
Huntington disease is an inherited neurodegenerative disease characterized by dancing chorea, psychiatric and behavioral disturbances, and cognitive decline. 3- nitropropionic acid (3-NPA) causes irreversible inhibition of the mitochondrial complex II enzyme (succinate dehydrogenase SDH) and increase ROS production. Centella asiatica (CA) is a strong antioxidant; it reduces oxidative stress, apoptosis and increases memory impairments. Aim: To validate model of 3-nitro propionic acid induced Huntington in adult zebrafish and investigate the effect of hydroalcoholic extract of Centella asiatica.

Material and method:
In this study, adult zebrafish (approx 3 months old), weighing from 470- 530 mg were used. Animals were treated with 3-NPA (5mg/kg and 10mg/kg) through I.P route on every fourth day for 28 days by using anesthesia tricaine (100 mg/L). Hydroalcoholic extract of Centella asiatica administered low dose (10mg/kg) and high dose (20mg/kg) in water tank daily upto twenty-eight days.

Results:
3-NPA treated zebrafishes showed behavioral alteration in light and dark compartment test, novel diving test, mirror chamber test and open field test. There were significant behavioral alterations in 3-NPA treated zebrafish as compared to the normal group. However, biochemical analysis remains to be explored. Therefore, the expected outcomes in Centella asiatica treated group may downregulate ROS and increase the antioxidant enzymes level and improve memory impairments.

Conclusion:
3-NPA at a dose of 5 and 10mg/kg causes fatal toxicity in adult zebrafish. Therefore, at the dose of 10mg/kg it causes severe toxicity and inflammation experimental animals. Reduction in oxidative stress, improvement in antioxidant level and improve memory functions can be considered as a significant mechanism of protection of CA against 3-NPA induced toxicity. Keywords: 3-nitropropionic acid, hydroalcoholic extract of Centella asiatica, oxidative stress, neurotoxicity

Cross-cultural evaluation of erotic and gory images of International Affective Picture System on an Indian sample

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Background and objectives:
The International Affective Picture System (IAPS) is a standardized tool composed of emotionally-evocative colored pictures across different semantic categories and subject matters. This database is internationally accessible and is used widely in research on emotions and attention. The emotional assessments of the pictures are characterized along three major dimensions: valence (how pleasant/attractive or unpleasant/aversive), arousal (how calm or excited was the intensity of activation), and dominance (how controlling). However, with regards to the Indian population, little is known about how people respond to IAPS pictures associated with erotic (high valence, high arousal) and gory (low valence, high arousal) content on different dimensions. The aim was to compare the self-reported Indian ratings with the normative ratings and their subsequent validation in India.

Methods:
We collected ratings from an adult Indian sample for an IAPS subset of erotic and gory pictures in the present study. Sixty participants (31 male, 29 female, Mage= 23.8 years, SD = 4.8 years) rated 72 arousal-matched IAPS pictures (36 erotic, 36 gory) on three affective dimensions— valence, arousal, and dominance. The images were dichotomized as high (positive) or low (negative) valence, with a threshold value of 5.00. Following the original system devised by Lang et al. (1980), the pictures were assessed using the Self-Assessment Manikin (SAM). SAM is a graphic figure depicting continuously varying pictographic scales to indicate emotional reactions along the three dimensions.

Results:
Results showed that for all the 72 pictures, both the Indian and the North American sample valence ratings were similar, but there were differences in arousal and dominance ratings. The arousal rating was significantly lower, while the dominance rating was considerably higher for the Indian sample compared to the North American sample. For the erotic pictures, the Indian sample rated them as less pleasant and less arousing but more in-control than the North American sample. For the gory pictures, the Indian sample rated them as more unpleasant and more in control but less arousing than the North American sample. The range values indicated that the affective ratings were less extreme for the Indian sample for valence and dominance dimensions compared to the North American ratings when we considered erotic and gory pictures together.
The correlations between the North American ratings and the Indian sample were highest for valence, followed by dominance and arousal. For the Indian sample, we found a significant positive linear trend between valence and arousal for erotic pictures and a significant negative relationship between valence and arousal for gory pictures. Thus, pictures rated as highly pleasant or unpleasant were rated as more arousing. The North American sample showed no significant positive correlation for erotic pictures; however, we observed a significant negative correlation for gory pictures. Thus, there is no relationship between arousal and valence rating for erotic pictures in the North American sample. However, pictures rated as highly unpleasant were rated as more arousing by the North American sample.

The IAPS ratings in the affective space of valence and arousal for the Indian sample showed a typical boomerang-shaped distribution like the North American sample and previous validation studies. Still, the distribution is more curved and deep compared to the North American sample. The ratings with the Indian sample did not show positivity offset (smaller intercept for positive pictures than negative pictures); there was negativity bias (steeper negative slope for negative pictures than positive pictures) like the North American sample. The intercept values, in general, were smaller, and the slopes were larger for the Indian sample compared to the North American sample. The main difference in rating

between the Indian and North American samples seems to be for relatively low-arousing— positive and negative pictures. The North American sample rated low-arousing, positive and negative pictures as almost equally less pleasant and unpleasant, respectively than the Indian sample. However, the Indian sample rated the low-arousing negative pictures as slightly more unpleasant than low-arousing positive pictures as pleasant.

There were crucial gender differences in the valence, arousal, and dominance ratings of erotic pictures. Females rated these pictures lower on valence and arousal but higher on dominance than males. The difference was presented along the dominance dimension for gory pictures, with females rating them higher than the males.

Discussion:

These divergences in arousal ratings could be due to numerous reasons, including cultural differences in interpreting affective information specific to erotic and gory pictures. One of the critical reasons could probably be cultural norms against sex, which are heavily ingrained in Indian society. The idea of sex, sexual desire, and sexuality is something to be hidden and may stop people from experiencing and expressing their desires even when explicitly asked to do so. This censorship often compels young adults to suppress their needs and desires, especially women. Even violent and gory pictures are not a part of Indian culture and are neither glamorized nor freely exhibited for general audiences. Another reason could be differences in interpretation of the construct of arousal and rating scale between the two cultures.

Conclusion:

The results imply that Indian researchers should be much more cautious about arousal and dominance, in comparison to the valence dimension for erotic (positive) pictures, and arousal, dominance, and valence dimension for gory (negative) pictures, when using an IAPS set for research in India. While the affective ratings show considerable similarity between the Indian and the North American sample, the present study strongly recommends careful consideration of country-specific and gender-specific normative ratings.

The Role of BMI and Perceptual Load in Attention Capture by Food Stimuli

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Background:

Past research on attention bias (AB) to food stimuli has been ambiguous. Attention bias can be studied using attention capture (Morris et al., 2020b). While many studies have an associated between AB to food stimuli with craving, obesity, weight gain and overconsumption of high-calorie unhealthy/processed food (Werthmann et al., 2011; Kakoschke, Kemps, & Tiggemann, 2015; Meule, & Platte, 2016; Hardman et al., 2021); few studies show a weak or lack of association between AB to food and: food consumption and body weight (Field et al., 2016; Hagan et al., 2020; Hardman et al., 2021). Generally, these studies use dot-probe or Stroop-tasks, whose AB indices are often scrutinised for their reliability (Nijs, Franken, & Muris, 2010; Vervoort et al., 2021). Moreover, none of the studies manipulated the levels of attention to examine attention capture by food stimuli. Therefore, a recent string of studies measured attention bias to food from a perceptual load framework. Morris and colleagues (2020a, b), who used only high-calorie sweet food, reported that the interference of food and food-related intrusive thoughts were reduced under high load conditions. Overall, the role of capacity limitations of attention appears to be an interesting new framework to study attention bias to food more reliably.

Aim:

Therefore, the current study aims to understand the distractor interference of low- and high-calorie food in the low- and high- perceptual based on high and low BMI.

Method:

Based on cultural validation that we did on an Indian sample, we selected 24 static food images from the food.pics extended database (Blechert, Lender, Polk, Busch, & Ohla, 2019). These images included 12 high-calorie (M=372.5 kcal, SD=123.6 kcal) and 12 low-calorie (M=84.3 kcal, SD= 41.9 kcal) foods that varied only based on kilocalories per 100g. We varied attentional resource availability by manipulating perceptual load in a well-established letter search task and introduced centrally placed food distractors during 25% of the trials. Similar to Gupta et al. (2016), we presented distractors in low probability to avoid moderation by habituation. The participants (N= 47, 70% females; M_{age}= 23.93, SD_{age}= 3.76) were then divided into high BMI (N=24) and low BMI (N= 23) group based on median (22 kg/m^2) to allow equitable distribution in both groups.

Results:

In error rates, the analysis revealed a main effect of load, where the error rate was significantly higher in the high-load (M = 36 %, SD = 13 %) than the low-load condition, (M = 5 %, SD = 6 %), $F(1, 45) = 325.32$, MSE = 204.53, $p < .001$, $\eta p2 = .88$, which confirms that our perceptual load manipulation was effective. There was a significant interaction between distractor conditions and group, $F(1, 45) = 367.01$, MSE = 76.91, $p = 0.011$, $\eta p2 = .096$. We also noted that the interaction between load, distractor conditions and group was marginal, p= .089.

Based on the apriori hypothesis and interaction effects paired sample t-tests were conducted. The t-tests revealed that in the high BMI group, the error rates of high- caloric density (M = 26%, SD = 12%) was significantly higher than those with no distractor (M = 21%, SD = 6%), $t(23) = 2.891$, $p = .016$, d =

.590. Note that in the high BMI group, the difference between of high- caloric density (M = 26%, SD = 12%) and low- caloric density (M = 21%, SD = 12%) showed an interesting trend, t(23) = 2.005, p = .114, d = .409. All other comparisons were not significant, all p's > .210.

Further comparisons reveal that those with high BMI, showed higher error rates during high- caloric density (M = 9%, SD = 9%) than no distractor condition (M = 5 %, SD = 5 %), t(23) = 2.716, p = .024, d = .554 in low- load conditions. The t-tests also revealed trends where during high- load condition in the high BMI group, participants showed higher distraction from high- caloric density food distractors (M = 43 %, SD = 18 %) than lowcaloric density food distractors (M = 36 %, SD = 19 %), (t(23) = 1.919, p = .134, d = .392). However, during high- load condition the low BMI group showed higher error rates for lowcaloric density food distractors (M = 36 %, SD = 15 %) than high- caloric density food distractors (M = 13 %, SD = 15 %), (t(22) = 1.76, p = .184, d = .367) were found. Note that the Cohen's d values show a promising moderate strength. All other comparisons were not significant, all p's > .350.

Distractor interference calculated based on error rates showed significant three- way interaction (F(1, 45) = 6.83, MSE = 94.67, p = 0.012, ηp2 = .132) and revealed trends similar to those in error rates. The results from RT data does not show any meaningful currently.

Conclusion:

The ongoing study shows trends in line with previous studies that have shown that there could be an enhanced orientation, longer engagement and poor maintenance of attention towards high-calorie foods possibly because they are often highly- rewarding and tasty (Castellanos, et. al., 2009; Siep, et al., 2009; Werthmann, et al., 2011). The results also contradict Morris et al. (2020b), who revealed interference to food stimuli to disappear under high-load conditions. A plausible reason could be that they only used high-calorie foods and had not accounted for BMI variability. The results could imply that incorporating perceptual load could help clarify the inconsistencies in food-related attention bias research. In addition, as we are living in an obesogenic environment filled with palatable, processed, high-calorie food, maintaining a healthy BMI could be challenging (Lake & Townshend, 2006). The results could also shed light on the cause and maintenance of unhealthy food consumption in those with higher BMI. BMI appears to be a sensitive score that interacts with attention to modulate attention capture by food, based on the caloric density. Therefore, reducing BMI could help deal with attention mechanisms underlying addiction to unhealthy food.

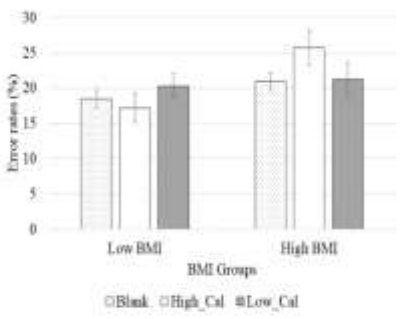

Figure 1. Error rates on the letter-search task as a function of distractors and BMI groupings.

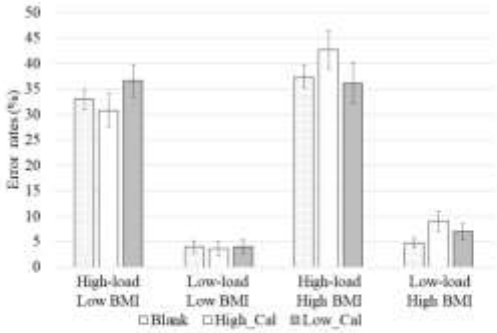

Figure 2. Error rates on the letter-search task as a function of distractors, perceptual load and BMI groupings.

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Personality Profiles of 'Troublesome' People

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Although not troubled by their behavior, some people are well known to cause excessive trouble for others in various settings such as occupational, educational, and interpersonal relationships. The classic diagnosis of such people is known as a personality disorder. Personality disorders are long-standing patterns of inflexible behavior, onset early in life because of a polygenic basis, and cause significant distress or impairment to oneself and/or others. These disorders have a 10% prevalence worldwide (Coolidge & Segal, 1998).

There has been a total of 22 different personality disorders across the seven versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association [APA], 1952), although the current DSM-5 (APA, 2013) currently lists only ten. The present study (class demonstration) analyzed which specific personality disorder traits were most commonly associated with Indian adults who were identified as troublesome by others.

The sample consisted of 38 undergraduate, graduate, and post-graduate students from the Indian Institute of Technology Gandhinagar, India. They completed an online psychological inventory form about one or two people they identified as troublesome, who were their relatives, friends, acquaintances, etc. The students received extra credit for participation. They identified 75 troublesome people (42 men and 33 women; 14 married and 61 un-married; years of education from primary school to graduate school degrees; mean age 26.72 years old; range 18-60 years old). The troublesome people remained anonymous.

The students completed the Significant Other Short-Form of the Coolidge Axis II Inventory (SCATI; Coolidge, 2019) that contains 70-items measuring 14 personality disorders. Each item is answered on a scale ranging from (1) strongly false, (2) more false than true, (3) more true than false, to (4) strongly true. The SCATI has been shown to be reliable and valid in various clinical and non-clinical settings (e.g., Coolidge et al., 2010; Fiala et al., 2020; Furnham & MacRae, 2020).

In the present study, the internal reliabilities (Cronbach's α) for the SCATI personality disorder scales were considered good to acceptable. The Histrionic scale had the highest α (.82), while the Passive-Aggressive scale had the lowest α (.30). The scales' underlying factor structures were examined by principal components analysis because Cronbach (1951) noted that α would be higher when a scale has a higher first-factor concentration. Consistent with our suspicions, the Passive-Aggressive scale had the lowest first component concentration (29.9%). Upon further examination, the correlation between the 14 personality disorder scales' α values and the percentage of the first component's variance was r = .96, which strongly supports Cronbach's claim that α is higher when a scale is measuring a unitary concept. Thus, lower internal reliabilities appear to be a function of a lack of high first-factor concentration.

Our participants found troublesome people to be higher on 11 of the 14 personality disorder scales (i.e., at least one SD above the normative SCATI mean [M]). The four scales with the highest T score mean, and respective prevalence's in the sample were: Sadistic (M=65.71; 40%), Passive-Aggressive (M=65.21; 37%), Self-Defeating (M=64.28; 28%), and Narcissistic (M=64.10; 40%). This finding is intuitively reasonable because these scales require major interactions with other people to express their personality disorder traits. The three scales with the lowest T score mean and respective prevalence were: Depressive (M=59.97; 19%), Schizotypal (M=59.05; 20%), and Obsessive-Compulsive (M=53.44; 9%). This finding is also reasonable as depressed people are generally unengaged with others, therefore less likely to be seen as troublesome. People with schizotypal personality traits are generally socially anxious and are also less likely to be identified as troublesome. Interestingly, people with obsessive-compulsive personality traits would be seen as less troublesome as they are often viewed

as stubborn, difficult, and unnecessarily demanding. However, people with these traits are obsessed with details, which college students might value.

Concerning gender differences, our participants identified 42 of the 75 troublesome people as men (56%) and 33 trouble people as women (44%). Although these percentages are not significantly different [χ^2 (1, n = 75) = 1.08, p > .05], the greater percentage of men in the present sample is consistent with the known prevalence rates for personality disorders. Eight personality disorders are thought to be more prevalent in men, and six are thought to be more prevalent in women. Concerning age, the sample could be considered relatively young as 80% of the total sample were under 30 years old, and only 6% were over the age of 50. This finding is consistent with DSM-5, noting that personality disorders arise by early adulthood or earlier. We also investigated the comorbidity among the 14 personality disorder scales using the criteria r > .50, p < .01. Six of the 14 personality disorders were comorbid with at least three other scales. Five other personality disorder scales were comorbid with at least two other scales. This finding substantiates the general understanding that personality disorders are more often than not comorbid with other personality disorders. There is some evidence that these comorbidities are the result of a common polygenic heritability. For example, it is well established that antisocial personality disorder is highly comorbid with sadistic personality disorder (Berner et al., 2003), which we found in our study (r = .65, p < .01). Also consistent with the literature, we found that the narcissistic and histrionic personality disorder scales were highly comorbid (r = .71, p < .01), most likely due to their strong need for attention from others (Segal et al., 2006).

In summary, despite our study's small sample and the recruitment of college students, we found that people can identify a troublesome person and that the latter have readily identifiable personality disorder traits. We also found preliminary evidence for clusters of profiles that were consistent in the literature for bullying behavior, which consisted of the Passive-Aggressive, Paranoid, Histrionic, and Dependent personality disorder traits, and a cluster similar to the Dark Triad, which consisted of the Antisocial, Narcissistic, and Sadistic personality disorder traits. We are planning to increase our sample size in order to substantiate these clusters.

Introducing a standardize affective picture set based on repetitious everyday life pictures in Iranian media

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Emotion has a prominent role in our everyday life experiences, as it enables us to react to different situations by evaluating the environment continuously (Frijda & Mesquita, 1994). Emotional experiences and human feelings have been receiving an increasing amount of attention because of their crucial role in the human behavior structure. Emotion and cognition have been shown to have a two-sided influence on each other (Gray, 2004) and emotion triggers the action response consistent with the condition (Inzlicht et al., 2015). Therefore, there has been a focus on studying different aspects of this connection with a variety of stimuli.
According to the dimensional theory, experiencing emotion is multidimensional (Fontaine, Scherer, Roesch, & Ellsworth, 2007; Gillioz, Fontaine, Soriano, & Scherer, 2016; Yik, Russell, & Barrett, 1999). Valence and arousal are the most popular dimensions for assessing emotion.

Visual stimulation has a prevalent application in the emotion research due to its versatility and convenient controllability. There are several studies based on standardized databases in line with the dimensional theory for affective visual stimuli (Lang, Bradley, & Cuthbert, 1999, Marchewka, Żurawski, Jednoróg, & Grabowska, 2014, Dan-Glauser & Scherer, 2011). However there exists a significant discrepancy in participants' response in the experiments across cultural groups (Riegel M et al., 2017). To-date, there are no standardized databases of visual stimuli compatible with Iranian culture and daily life experiences.
We created a set of emotional pictures standardize across valence and arousal and congruent with Iranian culture. The current study used 300 images selected from the images related to the most repetitious news in the domestic news websites. These pictures were categorized into three groups: positive, neutral and negative. 511 participants rated these pictures via an online web-app by their valence and arousal (each participant rated 50 pictures).

In line with prior research the average ratings for valence show a bimodal distribution and there exists a M-shaped relation between means and standard deviations of the valence ratings. The distribution for arousal average ratings is a normal distribution. Furthermore, means and standard deviations of the ratings approximately have a linear relationship and the relationship between the means of valence and arousal ratings follows a boomerang shape. We normalized our pictures by their valence ratings by excluding the pictures with high standard deviations and also the pictures which they received their valence rating incompatible with our initial assumption. Our final set consists of 150 affective pictures. This picture set can be used as an open-source material for the future studies.

Psycho-Social Correlates of Suicidal Ideation Among College Student

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College is a time many young adults feel a pressure to develop identities, develop life goals, and make meaningful relationships. Internal conflicts can develop when these complex social lives, academic roles, and extracurricular activities conflict with an individual's beliefs or schedule. Undergraduate college students are a unique at-risk population for development of suicidal ideation. The present study is intended to investigate psycho-social correlates of suicidal ideation among college student's suicidal ideation with hopelessness, loneliness, depression, psychoticism, extroversion, neuroticism, and family environment condition of undergraduate male and female from different Government Colleges of Sikkim. 400 undergraduate college students (200 males and 200 females) from four different government colleges of Sikkim are selected for data collection. Scales are used to collect the data by Beck Scale for Suicide Ideation (Beck & Steer (1993), Beck‟s Hopelessness Scale (Beck & Steer (1993), Loneliness Scale (Russell, Peplau, & Ferguson (1978), The Beck Depression Inventory II (Beck, Steer, & Brown (1996), Eysenck‟s Personality Questionnaire-Revised (Eysenck & Eysenck (1985), & Family Environment Scale Bhatia & Chadha (2012).

The results suggest that a significant and positive correlation existed between suicidal ideation with loneliness, depression, psychoticism, and negatively correlates of all the dimension of family environment among undergraduate college students. There exists significant gender difference among male and female undergraduate college students on loneliness, depression, psychoticism and neuroticism dimensions of personality and cohesion dimension of family environment. Loneliness, depression, personality, and family environment indicated significant predictor of suicidal ideation among undergraduate college students. After the rigorous efforts, the present study reached to its destination that highlights the fact that the male undergraduate college students of Sikkim have faced less competence in comparison to the female students. One of the reasons behind this could be the academic atmosphere in the colleges. Another problem among college students is loneliness and related risky behaviours for overcoming loneliness could be smoking, drinking, substance abuse, risky sexual behaviour, physical harm etc.

The benefit of knowledge generation using hands

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There is a significant body of research exploring the cognitive benefits of language, but relatively little research examining the cognitive benefits of generating gestures as an aid for conceptualization in biology. Unlike language, gestures are largely improvised, and represent a novel vocabulary to describe a concept in biology. To test the cognitive impacts of the act of generating gestures for biological concept, thirty-three college students were assigned to either a reading group (no-gesture group) or a group that was explicitly instructed to utilize gestures to make sense of the material (gesture group). Initially, both groups were instructed to read a text describing a human circulatory system. In the second phase, the no-gesture group was asked to read the same text again, but this time with the stipulation that they must hold the document with both hands. Alternatively, the gesture group was instructed to pause their reading of the text in order to model each structure of the circulatory system using hand gestures. By doing this, the gesture group had a chance to generate an image of the subjects described in the text visually and spatially. After these two study sessions, a knowledge test was performed, followed by a drawing test where the students were asked to draw a diagram illustrating how a human circulatory system works. It was found that there was not a significant difference between the groups' performance on the knowledge test. However, the gesture group showed better systematic understanding and deeper knowledge of detail on the drawing test. Benefit of generating an idea using hands was discussed.

Keywords:
Enactment, Level of engagement, Gesture, Learning, Generative

Neurocognition and COVID-19: The Identification of Neurocognitive Patterns in Patients with and without Anosmia

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Interestingly, one of the most commonly reported symptoms of COVID-19 is the loss of smell (anosmia), and its presence heralds the co-existence of COVID-19 better than the presence of a fever. Anosmia may also be a critical symptom because extant literature reveals the association of anosmia with neurodegenerative diseases like Parkinson's disease, Alzheimer's disease, and auto-immune diseases like Lupus. Recent research has already demonstrated the sequelae of the virus has various negative impacts upon cognitive functioning. In a single cohort study, Almeria et al. (2020) observed that thirty-five hospitalized COVID-19 patients aged between 20-60 years of age who underwent oxygen therapy had lower memory, attention and executive functions compared to asymptomatic patients. Anwar et al. (2020) noted the increased risk of neurodegenerative diseases post COVID-19 infection, particularly Alzheimer's disease in elderly population. Importantly, COVID-19 may affect several mechanisms that lead to cognitive dysfunctions (delirium, encephalopathy, mood disturbances) either directly or indirectly (Roozbeh et al., 2021). According to Pilotto et al. (2021), age, premorbid conditions, severity of the infection, and duration of hospitalization determine the extent of potential neurological repercussions in COVID-19 patients. Importantly, Rebholz et al. (2021) noted the crucial role of olfactory dysfunctions (anosmia/hyposmia) induced by the COVID-19 virus in triggering sensory-motor and cognitive symptoms. Recent neuropsychological studies have shown the long-term cognitive impairments after COVID-19 infection involve memory problems, slower processing speed, reduced concentration and attention span, executive dysfunctions, and affective disorders including depression, anxiety, and post-traumatic disorders (Rogers et al., 2020; Hampshire et al., 2021; Woo et al., 2021; Kumar et al., 2021; Manzo et al., 2021; Ferrucci et al., 2021). It is known that the virus primarily enters one's body through the olfactory epithelium of the nose, which enter directly into the olfactory bulbs through the cribriform plate (in the anterior and ventral portions of the skull). It is thought that the human immune system reacts to pathogens using either pro-inflammatory (M1) or anti-inflammatory (M2) processes. The virus, by using this olfactory route, not only damages the olfactory sensory receptors, but also causes a loss of smell (anosmia) or a disruption in smell (hyposmia). Neurological examinations in deceased COVID-19 patients show sustained exposure to severe inflammations and higher levels of cytokine (M1) that are responsible for sudden alterations in innate immune responses. However, it has not yet been established what specific symptoms and patterns of neurocognitive dysfunction are associated with those COVID-19 patients who exhibit anosmia/hyposmia. Further, it is not yet known whether these symptoms and patterns are different from COVID-19 patients who do not suffer from anosmia/hyposmia. Thus, we are currently assessing the neurocognitive symptoms of patients who have contracted COVID-19 and compare the pattern of symptoms between those patients with and without anosmia/hyposmia. Another lacuna in this literature is that the cognitive dysfunction in COVID-19 patients has not been assessed in a comprehensive manner. One unique aspect of our present study is that we are assessing (by patient's self-report on 47 neurocognitive items) some of the major domains of Neurocognitive Disorder, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). These domains include inattention, learning and memory problems, executive dysfunction (e.g., poor planning, decision-making difficulties, etc.), receptive and expressive language problems, and perceptual-motor impairments (e.g., drawing difficulties, hand-eye coordination problems). Participants are also being tested for the presence of anosmia/hyposmia (a 10-item multiple-choice smell test) and neuropsychological laboratory measures (trail making test, digit span test, Wechsler memory scale) primarily assessing frontal and temporal lobe functioning. The findings of the present study should help in identifying whether the presence of anosmia and its duration have a differential neurocognitive impact. Also, our study would help to clarify the neuropsychiatric and cognitive complications resulting from the psychosomatic response to the potential physiological and the mental stress associated with recovering

from COVID-19. Further, the findings should also be helpful in developing cognitive interventions for the patterns of neurocognitive dysfunctions that arise in this affected population. We will report our preliminary results at the 8th ACCS conference.

Occasion Noise is moderated by Expertise: Insights from over a Billion open-source chess Games

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We are making judgments all the time, and studies show that when presented with the same evidence, our judgments may be different on a day-to-day basis. In the book "Noise: A Flaw in Human Judgment"(Kahneman et al., 2021), Nobel Laureate Daniel Kahneman and colleagues demonstrate that wherever there is judgment, there is Noise—**and more of it than you think**. The Authors provide crisp measurements and examples of error, breaking them down into Noise and bias. While bias has dominated headlines, the authors show why **Noise is typically a much bigger problem** and ignored in Research.

The influence of Noise can be gauged from studies done in the Medical Domain where it was found that:

1. Radiologists disagree on mammogram readings (0-50% false negatives, 1-64% false positives)
2. Cardiologists disagree on artery blockage in angiograms in >30% of cases
3. Dermatologists disagree on melanoma diagnosis in about 1/3 of cases — and are wrong in about the same % of cases
4. Psychiatrists only agree that a patient has depression between 4 and 15% of the time
5. Prescriptions are significantly influenced by the time of day

The Noise is further broken down into Level Noise (On average, some judges are more severe than others), Occasion Noise (If faced with the exact case twice, a judge will not judge it identically), and Pattern Noise (Each judge has a different preference and views on each case).

Based on the findings in the above book and to the best of our knowledge, the research findings on Noise are based on smaller sample size, conducted in the lab, or based on results from questionnaires and hence lack ecological validity.

We think that Games can be used as an experimental Paradigm for understanding the levels of Noise described above. Games have gained popularity as a paradigm for studying cognition (Brändle et al., 2021). Games offer several advantages: the availability of Big Datasets, prolonged episodes of playtime for each participant, diverse category (Novice vs Experts, Playtime, skill improvement, etc.) of participants, and better alignment with real world complexities. Games are not just one environment for studying human Behaviour; they are the best environment. They are complex enough to simulate actual physical and social systems with great precision. Games are like laboratory experiments in psychology, with decisions constrained enough to be digitized and analyzed but not so constrained (e.g., down to binary yes/no answers) as to sacrifice much validity. Among Games, Herbert Simon and later John McCarthy, among the co-founders of AI (Artificial Intelligence), have referred to chess as the Drosophila of AI.

To systematically understand the Noise, we analyzed 36 million Chess games, from the opensource lichess.org database, by 9 million Players from 2018 to 2020(longitudinal study) by individuals ranging from amateurs to masters. In the current study, we plan to identify the factors influencing the performance and Average Errors and empirically quantify Noise.

We Test the following Hypothesis (Controlling for only single-use sequence knowledge (Chassy, P., & Gobet, F. (2011). Measuring chess experts' single-use sequence knowledge: an archival study of departure from 'theoretical openings. PLoS One, 6(11), e26692).

Our Preliminary Results Indicate:

1. Level Noise correlates with Expertise (ELO Rating – Measure of chess strength)
2. Occasion noise correlated with the influence of Prior Result on Current Game (measured by Average Quality of Play in Centipawns) and moderated by Expertise.
3. Pattern Noise correlated with Risk taking attitude based on the opponent Strength (as measured by Opponent Players ELO Strength)

We have randomly sampled 25 games for each factor, and using 2 x 3 ANOVA, we specifically tested whether prior result (Win, Loose) play a role in the average errors (centipawn loss) in the current Game, and whether these blunders differ across expertise levels (as measured by ELO Rating – grouped by L1, L2 and L3 (below 1 SD, Mean, and Above 1 SD from the mean respectively). Theoretically, the prior result should not influence the current game, but the results indicate that the prior result indeed influences the current result.

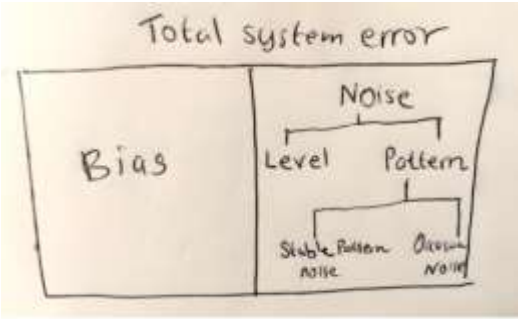
A two-way ANOVA was performed to analyse the effect of expertise and Prior-Game-Result on Average Errors (in Centipawn) [The average errors were measured in opening phase of the Game as derived from lichess.org API].

1. A two-way ANOVA revealed that there was a statistically significant interaction between the effects of expertise and Prior-Game-result (F (2, 144) =, p = .031).
2. Simple main effects analysis showed that expertise did have a statistically significant effect on Average Errors ($p < .001$).
3. Simple main effects analysis showed that Prior-Game-Result did have a statistically significant effect on Average Errors ($p < .001$).

Though the impact of prior result on current Task has been empirically found in simple tasks like Stroop Tasks and explained via Graton effect, there does not exist an exhaustive and ecologically valid research in complex tasks like chess.

Tests based on larger sample sizes are currently underway, and we hope to validate and publish the results in the coming two weeks.

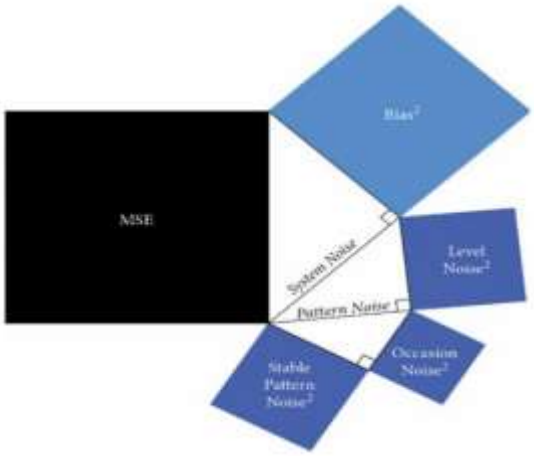
Results & Descriptive Statistics:



ANOVA - Average Error

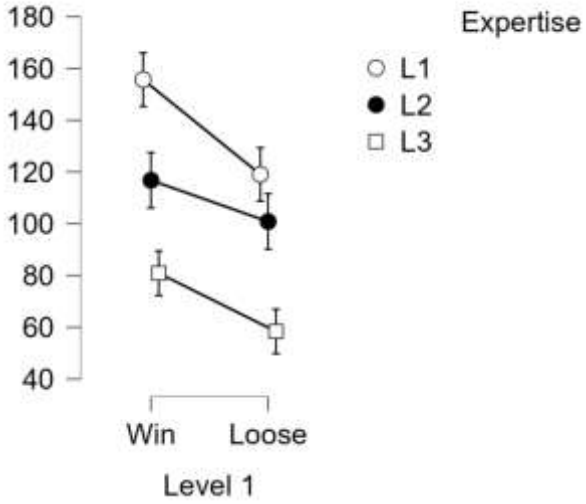
Cases	Sum of Squares	df	Mean Square	F	p	η^2
Expertise	129197.719	2	64598.859	132.455	< .001	0.591
Prior Result	15677.278	1	15677.278	32.145	< .001	0.072
Expertise ✻ Prior Result	3465.991	2	1732.995	3.553	0.031	0.016
Residuals	70229.510	144	487.705			

Note. Type III Sum of Squares



Descriptive

Level 1	Expertise	Mean	SD	N
Win	L1	155.688	26.190	25
	L2	116.795	30.453	25
	L3	80.900	18.517	25
Loose	L1	119.049	17.140	25
	L2	100.858	14.817	25
	L3	58.397	16.188	25



Quercetin Alleviated Rotenone-induced Neuroinflammation, Memory, and Cognitive Alteration in Swiss Albino Mice

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Nowadays' s environment is unceasingly exposed to a variety of toxic agents like heavy metals various harmful chemicals. Among them, pesticides are inimitable contaminants of the environment that are precisely introduced into the atmosphere to regulator pests, frequently by killing them. Though the application of pesticides helps in various significant motives, involving defense against loss of crop and against various vector-borne diseases, there are important concerns over the probable toxic impacts of pesticides to non-target organisms, such as humans. This exposure contributes to the development of various kinds of neurodegenerative and psychiatric symptoms such as cognitive alteration, anxiety, stress, fear, and depression in organisms. Rotenone is the pesticide and well-known inhibitor of complex I of mitochondria widely used to reproduce Parkinson's disease model. The current study was designed to investigate the impact of rotenone on neuroinflammation and behavior alteration. Along with this we also examined the protecting role of quercetin against rotenone-induced toxicity. Quercetin is a natural flavonoid that is abundantly found in fruits and vegetables has been possessing a lot of biological roles involving antioxidant, anti-inflammatory, and neuroprotective properties. The finding of the present study specified that rotenone 5 mg/kg body weight through oral gavage for 60 days leads to the secretion of proinflammatory markers IL- 6 in blood serum, activation of astrocytes in substantia nigra and hippocampus, decreased density of dopaminergic fibers in the striatum. Rotenone also caused alteration in memory of the mice as stated by diminished spontaneous alternation in Y-maze test, T-maze test and decline in exploration time in Novel object recognition test, enhanced immobility time in Forced Swim Test and decreased muscular strength. Co-administration of quercetin 30 mg/kg/day for 60 days through oral gavage along with rotenone reversed all these adverse impacts, signifying that quercetin can decrease neuroinflammation and increase cognitive function, memory, and decreased depression and anxiety. Briefly, our finding indicated that natural flavonoids like quercetin may be valuable against pesticide-induced neurological disorders and behavior alteration. This finding may contribute to the developing therapeutic strategy using a plant-based compound like quercetin against neurodegenerative disorders and other psychiatric signs induced by environmental agents.

Visual Memory Enhancements Near the Hands

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Past studies have shown changes to Perceptual and Attentional mechanisms in the processing of those information presented in the reachable space of the hand- often termed as the Peri personal Space (PPS). The PPS holds tremendous relevance since it is here that physical contact with objects occurs while performing every successful voluntary action efficiently. PPS is also important considering that the space acts as a buffer zone- preparing the motor system to execute defensive action(s), if required- against a fast-approaching dangerous object towards the body. That is, there is a certain action-preparedness of the motor system, specific to stimuli especially when they enter the PPS. The action-preparedness have been observed in the form of early visual effects such as superior ability to discern distance and orientation information of objects, segregate figure and ground information of stimuli, and inspect temporally contiguous visual events occurring in the PPS. It has also been argued that objects in the PPS receive attentional priority, with no such prioritization seen when these objects are placed beyond the PPS. Further, attentional shifts have also been found to be slower for objects in the PPS- with no such slowing down observed for objects when they are placed beyond the PPS- implying increased dwell time for objects placed in the PPS. These findings imply increased allocation of attentional resources that is restricted to objects when placed in the PPS, and not beyond. Therefore, information presented in the PPS seems to have enhanced representational strength over that information presented beyond this space. However, the extent and nature of the PPS-related effects on vision and other cognitive mechanisms are not known. It is reasonable to expect the PPS-related effects to extend beyond early vision, to 'later' stages of information processing, such as cognitive control, emotional processing, language and memory.

However, the objective of the present study is to look for possible enhancements in the Visual Short-Term Memory for information presented in the PPS. That is, we examined the nature of stimuli that get preferential processing, especially when they are presented near the hands, in comparison to those stimuli presented relatively far. The 'near' hand condition in this study was operationalized in the form of participants placing their hands on both sides of a computer monitor, whereas the 'far' hand condition required the hands to rest on the lap. Participants were required to complete a change detection task in which they were asked to determine whether two sequentially presented arrays of various colored and oriented lines were the same or different. The change condition involved change in either the color, orientation or both color and orientation, of one of the lines in the array, as shown in **Figure.1**. The participants did not know which features would change in advance. Thus, this task required them to memorize the whole aspect of the first array and then compare its visual memory representation with that of the second array. Since information retention depends on the quality and contents of visual

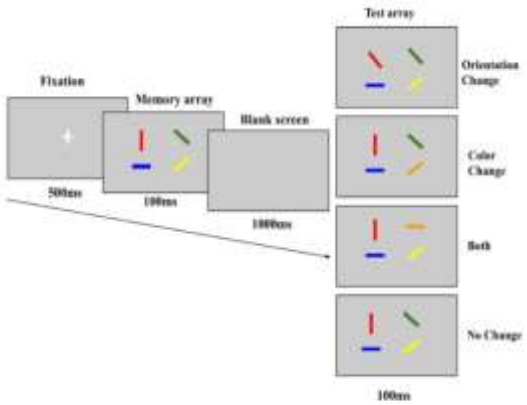
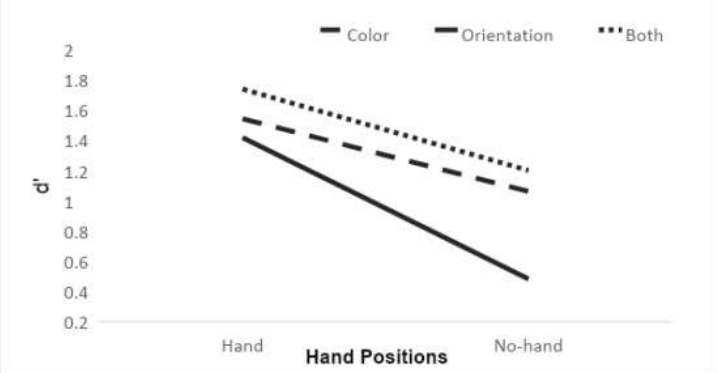


Figure.1. Schematic illustration of the stimuli and four trial types used in the experiment.

working memory, the current task can reveal whether one feature has any representational priority over the other when hand position is manipulated between near and far.



The d' prime scores were calculated for change type (Color, Orientation, and Both) as a function of Hand position (Hand and No-hand conditions). A 2 (Hand position: Near and Far) × 3 (Change type: Color, Orientation and Both) Repeated Measures ANOVA was performed on the d' values obtained **(Figure.2).**

Figure.2. Change detection performance as a function of hand position (Hand and No hand) and change type (Color, Orientation, and Both).

A significant main effect was obtained for the Hand position, F (1, 14) = 11.02, P=.005, ηp^2=.44. Overall, the d' sensitivity to the change types were higher for the Hand condition (1.57) compared to the No-hand condition (.92), implying relatively better retention of the information presented in the peri-hand space compared to the baseline No-hand condition. Pairwise comparisons revealed relatively higher sensitivity for color and orientation features in the Hand condition compared to the No-hand condition (t (14) = 2.21, p = 0.04 and t (14) = 7.83, p = 0.001, respectively). However, sensitivity to changes to both orientation and color features could not reach statistical significance between the Hand (d' = 1.74) and the No-hand conditions (d' = 1.20). No significant main effect was obtained for the Change type (p = .21), implying no overall sensitivity differences between the stimulus types used. Also, no significant interaction was found between Hand position and Change type (p = .55).

The results suggest better retention of color and orientation information presented in the near space of the hands; seen in the form of heightened sensitivity to changes to both the stimulus types. The enhanced retention seems to be because of a processing bias mediated by the magnocellular pathway and is in line with previous findings. However, no sensitivity differences in detecting changes to both orientation and color features between the near and far spaces of the hands could be because, encoding and remembering more than one feature could have resulted in a potential processing bottleneck for the information presented near the hands. The finding also implies reduced feature binding for objects near the hands and is consistent with the M-cell enhancement account of altered visual perception near the hands. Overall, the present findings highlight that the hand-related effects could extend beyond perception and attention to other cognitive phenomena such as visual short-term memory.

Interaction between Enumeration and Perceptual Averaging over different Presentation duration

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Magnitude Perception in the visual domain includes enumeration and perceptual averaging. Enumeration is a process of estimating the number of objects while Perceptual averaging is perceiving the average value of a feature of an ensemble. In the present work, we are studying how these two different processes influence each other. In Experiment 1 participants responded to two kinds of tasks, numerosity comparison and mean size estimation. We adapted the participants to fixed numerosity and a fixed mean size of a set of black dots. We showed 30 displays of 13 black dots over a period of 1-2 min. The individual size of the adaptations as well their location varied in each display. The mean size of the dots in each display was set to 50px. Test stimuli vary in numerosity of 4,7,10,15,18,21 and mean size of 18,25,35,65,75,90. Participants (n = 22) were asked to compare either numerosity or the mean size of the set with the reference value. A total of 72 trials (36 for each process) were displayed following the adaptation. For every subject, we separated the numerosity and mean size trials. The proportion of trials where the test numerosity or mean size is perceived more than reference is plotted against the test and fitted with the Weibull function. The independent variable was number ratio (n/nref, nref = 13) and size ratio (s/sref, sref = 50 px) in number and size trials respectively. We obtained the point of subjective equality (PSE) for number and size trials separately from the fits. The PSE for both number and size trials were very close to 1 showing more veridical representation. For both numerosity and perceptual averaging the main effect of PSE was not significant ($F(1,42) = 0.04421$, $p = 0.3917$). We concluded this was because participants were given unrestricted time to respond to the trials. In Experiment 2 (n = 24) we decided to restrict the test stimulus display. We made the test stimuli appear for three different durations 68ms,500ms and 1s. In this experiment numerosity and average size, values are the same as in the previous experiment. A total of 216 trials were displayed, 72 for each duration. Again, the proportion of trials where the test for each duration is perceived more the reference is plotted against the test and fitted with the Weibull function. We calculated the Point of Subjective Equality for each subject and each duration. The Median of PSE values for the Enumeration and Mean size was plotted against test stimuli duration. For both the Enumeration and Size PSE values are close to one for 68ms. For the test of the main effect between enumeration and size, we have conducted a 2-way ANOVA test. We have got a statistically significant variance at the $p = .002$ level ($F(1,138) = 9.96$, $p = .002$). We observed that in the numerosity comparison task people overestimate the apparent numerosity for all three durations. The median of PSE values was constant over the duration, while in the perceptual averaging task the PSE values were increased with the test duration, showing an overestimated to underestimated behaviour. In experiment 1 participants have given unrestricted time to respond to the stimulus and the results show that they were more accurate compare to the second experiment in which the duration of test stimuli was restricted. From both the experiments we can conclude that both numerosity and mean size tasks dependent on the time for which they are presented for an accurate estimation.

Impairments in navigational search strategy switching during early stages of disease pathogenesis in a mouse model of Alzheimer's disease

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Carriers of mutations associated with familial Alzheimer's disease are known to develop subtle cognitive deficits <25 years before they develop dementia. Therefore, timely and accurate diagnosis is critical for the development of treatments for the initial stages of Alzheimer's disease. Using APPswe/PS1dE9 (APP/PS1) mouse model of Alzheimer's disease, we systematically evaluated the mild cognitive deficits during the early stages of disease pathogenesis, using the Morris water maze spatial learning paradigm.

Conventional behavioral analysis using this model indicates an intact spatial memory at 2 months of age. In this study we used an alternative method of analysis by focusing on the unsuccessful trials during water maze learning rather than the successful ones, to understand the nature of cognitive deficits more accurately.

APP/PS1 mice displayed higher number of unsuccessful trials during initial days of training unlike their wild type counterparts. However, with repeated trial and error learning, APP/PS1 reached levels comparable to wild type during later days of training. Individual APP/PS1 mice also exhibited disrupted transitions of search strategies, and an enhanced preference for non-cognitive strategies, that led to abrupt learning transitions, and increased number of unsuccessful trials. These findings suggest the significance of subtle intermediate readouts, that are the real harbingers of impending conditions such as Alzheimer's disease.

Recall Errors for Features in A Single Object Increases with Intervening Recall Probe Question

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Working Memory is believed to be limited in capacity. The interference model supports the limited capacity of the Working Memory. It states that upon the arrival of a newer object, which is to be maintained in memory, the recall of the older objects is interfered with. The recall of the object's information can be strengthened by the process of rehearsal, but this is possible for only a limited piece of information before it decays beyond recovery. We want to understand whether rehearsal can help in minimizing the interference in recall of features of the same object. So, we investigated the recall accuracy of the features of a single object. In the current study (n =24), we designed an experiment in which a circle was taken as the stimulus with varying color, size, and location randomly over a total of 400 trials. In this experiment we probed recall of the color and the location features of the circle. We considered two conditions to study the recall accuracy, a repeat and a non-repeat condition. In the repeat condition the same feature was probed twice (either color or location) in a sequential manner. In the non-repeat condition both features were probed and presented one after the other in a random order. Both the conditions were randomized in the experiment. The responses were mapped onto a continuous variable. The recall response for color was mapped onto a color wheel, which rotated every time the color feature was probed and for the location a mouse click at the center of the stimulus position was recorded. We observed an increase in the recall errors for both color and location features when they were probed second in line in case of repeat and non-repeat conditions both. We calculated z-scores for every error of recall for all the participants before analysis and conducted n-way within subjects repeated measures ANOVA, for the z-scores of the errors, where the factors were the type of feature of an object (color, location), trial condition (repeat, non-repeat), serial position of the question asked (one, two). The results showed a main effect of the serial position of the question asked ($F(1,112) = 266.899$, $p<<0.001$), and a significant interaction term ($F(3,112) = 54.801$, $p<<0.001$). There was no effect observed for the feature of the object. Hence the Interference model is not enough to explain these results in the absence of a second object. There might be some underlying mechanisms that are causing this interference in the recall other than one caused by the retention/maintenance.

The decrease in Vitamin D and changes in white matter integrity leads to cognitive impairment in elderly population from Northern India

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Background:
Vitamin D is a neurosteroid hormone that regulates neurotransmitters and neurotrophins. Moreover, it is also helpful in the prevention of amyloid accumulation and promotes amyloid clearance. Emerging evidence suggests its role in the reduction of Alzheimer's disease hallmarks such as amyloid-beta and phosphorylated tau. Many preclinical studies have supported the hypothesis that vitamin D leads to attentional, behavioral problems and cognitive impairment.

Methodology:
The elderly population from age group (55-75) years from either gender was screened on the basis of clinical symptoms, Montreal cognitive assessment test (MOCA) psychological test and white matter integrity using MRI imaging test. Further serum Vitamin D level was assessed using enzyme linked immunosorbent assay method following manufacture protocol.

Result:
50 cases of controls with mean age 61.75±2 years; MOCA score 29±1 and 35 case of mild cognitive impairment (MCI) with mean age 60.25±3 year was screened with MOCA score 27±2. The white matter integrity in MCI cases was significantly altered as compared with controls. The values of Fractional Anisotropy (FA) in MCI cases were significantly lower in Left frontal lobe, Left and right Fornix as compared with controls, although Apparent diffusion coefficient (ADC) value was higher in Left and Right Parietal lobe, Occipital lobe, Hippocampus, Fornix, left minor forceps and right minor forceps of MCI cases as compared with controls. Further serum Vitamin D in MCI cases was 59.4±2 and control were 81.1±5.

Conclusion:
The data from the present study emphasize that the decrease in serum vitamin D level in MCI cases result in cognitive impairment in elderly population and changes in white matter integrity in brain regions are result of neurodegeneration that might lead to Alzheimer’s disease

Emo-Spots: Detection and Analysis of Emotional Attributes through Bio-inspired facial landmarks

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Modern engineering society requires qualified solutions to many practical problems, to meet accurate outcomes. Emotion detection through face landmarks has unique coordination towards improving the feedback system. Bioinspired learning methods are an interesting area of research. Face expressions are detected through various methodologies. Bio-inspired techniques are used to extract the facial landmarks to detect the face expression even better. The selection of face attributes is crucial for the prediction of deeper emotions. The proposed system is focused on implementing a bio-inspired facial landmark detection system for emotion extraction. The dataset used for the analysis is taken from the (JAFEE) Japanese female face expressions dataset. It consists of a collection of unique expressions and recorded images. Human face attributes are extracted from the Haar cascade model. The proposed novel methodology is derived with the Robust Emo-Spot Extracting technique (RESET) using Point Mapping model based Landmark mapping for pre-trained images and labelling spots. The face images are correlated with databases and classified the type using a Deep convolutional neural network, in which appropriate Emo-spots are mapped using RESET. The adjustable Emo-Spots are randomly tuned using the randomly looped K-nearest neighbour algorithm. The novel algorithm checks for the correlation ratio (CR) 20. The proposed system is compared with the state-of-art approach in terms of accuracy.

Keywords:
Affective computing, deep learning, face recognition, face landmarks, emotion detection. I

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A Study on Parkinson's Disease Under the Context of Reinforcement Learning

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Reinforcement Learning (RL) is a flexible learning approach, where prior experiences are used to enhance the outcomes. The aim of the proposed work is to assess the mechanism governing the reinforcement learning in Brain. To understand this concept of RL in brain, an idea has been proposed to study the dynamic behaviour of Parkinson's Disease, a neurological condition related to the lesion of Basal Ganglia. The clinical diagnosis of this pathological state can be studied in detail by incorporating physiological knowledge with different neural pathways. To reduce the complexity of the model, the proposed work focuses only on the Cortico-BG-Thalamo-Cortical loop. The RL model mainly includes two pathways operating in the Basal Ganglia circuitry. The factors affecting the depletion of dopaminergic neurons like acetylcholine, oxidative stress, Lewi body formations etc are converted into mathematical models. An artificial environment can be implemented with these factors, for the agent to learn. The RL agent is also expected to learn these factors from the environment using an off-policy Olearning approach. By mapping the conditions affecting PD (mathematical formulations) with states (parts of Basal Ganglia) and actions (taking direct path or indirect path), the agent(neurons) can learn these factors within a couple of value iterations, thereby selecting an indirect pathway resulting in tremor. The demonstration of PD tremor and visualization of these value iterations can be accomplished with the help of a Virtual Robot (ML agent), implemented in UNITY platform. Moreover, hyper direct pathway can be added to identify the different sites involved in the treatment procedure of PD tremor, Deep Brain Stimulation (DBS). Eventually, an idea is also proposed to address the issues in the DBS, where an artificial deep model can also be developed to learn the brain signals of healthy control and patients with tremor. The model may be capable of learning these brain frequencies and reproduce an equivalent frequency as that of healthy control. This may help neurosurgeons in programming the implanted device during the treatment procedure. Thus, the proposed bridging work implements a flexible RL agent that can learn reliably the factors affecting PD from a dynamic environment like brain and thus integrates the field of Artificial Intelligence and Neuroscience.

The proposed study is influenced by the major objectives:

i. To study the dynamic behavior of Parkinson's Disease using an artificial Reinforcement Learning model.
ii. To introduce the role of overactive acetylcholine in Parkinson's tremor.
iii. To explore whether the reward processing and decision making in human brain are similar to the RL algorithms used in Artificial Intelligence and thus bridging the gap between AI and Neuroscience.
iv. To visualize the Parkinson's tremor (with the help of a Virtual Robot-ML agent) in UNITY platform and understand how these factors affecting the depletion of dopamine neurons will lead to the selection of indirect pathways

Introduction:

Neuroscience is an interdisciplinary field that focus on the functional, cellular, computational aspect of brain and nervous system. Human brain is a highly complex and dynamic organ. Studies have unveiled that an immense portion of the brain updates the value functions for taking suitable decisions. To study the basis of reinforcement learning in brain, a part of the brain, Basal Ganglia [1][2] has been selected. Apart from the basic functionality of motor control and coordination, BG is also responsible for reinforcement learning and action selection. The recent neuroscience research also discusses about the malfunctions of BG which may lead to the sequence of diseases, mainly Parkinson's Disease. Biophysical computational models are powerful tools for the study of these neurological diseases [3]. In the proposed work, the modelling focus on the cortico-BG-thalamo-cortical circuit that helps to explore the dynamic behaviour of parkinsonian network [4][5]. The model includes direct and indirect

pathways operating in Basal Ganglia circuitry [6]. Dopamine that binds to D1 receptors are excitatory and dopamine that binds to D2 are inhibitory in nature [7]. Dopamine binds to D1 will stimulate the GABA neurons in striatum which in turn stimulates the GABA neurons in GPi thereby allowing the thalamus to send a signal initiating the movement (This happens via direct path way). In a condition like Parkinson's disease, dopamine neurons are reduced in substantia nigra ie dopamine does not binds to D2 receptors. Thus, GABAnergic neurons become overactive and secretes GABA which inhibit the neurons in Gpe. The Glutamatergic neurons in subthalamic nucleus is not inhibited thereby stimulating the GABAnergic neurons in Gpi. Similarly, dopamine does not bind to D1 receptors. The overactive GABA neurons from GPi inhibits the thalamus. So, there is an excessive inhibitory action to thalamus. And thalamus inhibition causes suppression of the thalamo-BG-cortico pathway. (This happens via indirect pathways). From the simulations, the altered dopamine levels illustrating the pathological case (dopamine depletion in Parkinson's disease) and the healthy conditions are to be studied. One of the

Fig 1. Agent-Environment Interaction

common symptoms of PD is tremor [8]. An increase in acetylcholine may also lead to PD tremor [9]. PD tremor is also known as "pill rolling" [10] as it occurs mainly in hands. Experts have found that people with PD often have a decrease in dopamine that permits acetylcholine to take over. To reduce the symptom of tremor, a medical device neurostimulator is implanted in the brain with the help of neurosurgical procedure. Unlike the supervised and unsupervised learning, Reinforcement Learning [11] is an agent-based approach in which actions are taken based on the maximum expected reward. Considering the brain as a computing device and the neurons as the agent interacting with the environment, a learning algorithm like Qlearning[12] and the Policy evaluation and control algorithms like Dynamic programming [13] can be experimented on the model. It is assumed that the human brain also updates the value function based on the same concept. In RL, the reward hypothesis states that the possible outcomes can be achieved by maximizing the cumulative sum of the reward values. In the proposed study, the MDP [14] framework based on markov property can be used for decision making. Here, agent in an environment interacts at discrete timesteps. At each time step the agent reaches the state St based on an action At. A scalar reward of Rt+1 has been given

by the environment. The agent interacts with the environment providing a path consisting of states, actions and rewards. An agent-environment interaction is shown in Fig. 1. Future rewards [15] and states are influenced by the actions.

According to the Markov property, the present state contains all the information necessary to predict the future. There are episodic and continuing task in MDP. But interaction between the agent and the environment breaks into episodes in episodic task. Each episode ends in a terminal state and they are independent. But in Continuing task, interaction continues without any terminal states. The proposed work can be based on episodic task. A Policy maps each state to an action. It can be Deterministic and Stochastic Policies. Another important concept in RL is Reward computation [16]. The current and the future states are related with Bellman equations. The Parkinsonian network can be studied in detail by integrating the Cortico-BG-Thalamo-Cortical loop in the brain (BG) and the MDP based Reinforcement Learning model in AI.

Methods:

Fig 2. Expected model structure

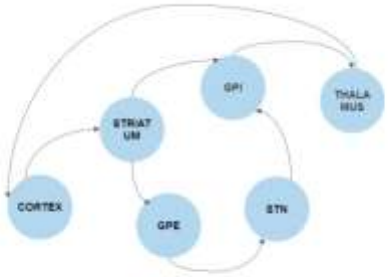

Fig. 3. Reinforcement Learning model structure expressed as Markov Decision Process (MDP)

The mathematical models formulated from the factors affecting PD like acetylcholine, Oxidative stress [17], Lewi body formation [18] are mapped as environment variables, which helps the agent to constantly interact with the environment through the exploration-exploitation method. A positive reward will be given to the agent for selecting the indirect pathways which reflects the Parkinson's state. The agent has to maximize the future rewards rather than immediate rewards. This can be achieved with the help of Bellman equations:

$$q_*(s,a) = \mathcal{R}_s^a + \gamma \sum_{s' \in \mathcal{S}} \mathcal{P}_{ss'}^a v_*(s')$$

An expected model structure is given the Fig. 2. The overall learning can be enhanced with an OffPolicy Q-learning approach. Since the role of our agent is to learn as it goes instead of following some policies, an off-policy approach will be more effective in any dynamic environment. Moreover, to maximize the future expected rewards, policy control and policy evaluation algorithms like Dynamic programming can also be used. Reinforcement Learning model structure expressed as MDP is shown in Fig. 3. Since adding more pathways may lead to a complex model, the RL algorithms like DQ-learning [19] can also be incorporated to study the treatment procedure of PD tremor, DBS [20].

Conclusion:

In the proposed work, a fully artificial reinforcement learning model has been proposed to understand the dynamic behaviour of Parkinson's Disease. The genesis of PD tremor can also be learned by considering the mathematical models of factors affecting PD like acetylcholine concentration, oxidative stress etc. Also, a method is proposed to create an artificial environment with these factors, for the RL agent to learn. The model uses an off-policy Q-learning approach to learn these factors and there by selecting an indirect pathway resulting in tremor. Finally, the demonstration of the condition is possible with the help of a Virtual Robot developed in the UNITY platform. Hence, this bridging work can integrate the field of Artificial Intelligence and Neuroscience.

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Effect of multi-talker noise at different SNRs on listening effort among individuals with noise induced hearing loss

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Background:
Noise-induced hearing loss (NIHL) is the second most common form of sensorineural hearing loss (Rabinowitz, 2000). Out of all other causes of sensorineural hearing loss, approximately one-third of hearing loss can be attributed to noise exposure (The National Institutes of Health, 1990). Kumar, Ameenudin, & Sangamanatha, (2012) reported temporal processing impairment in individuals exposed to noise than those who do not have a history of noise exposure. The purpose of the study is to investigate the allocation of cognitive resource in understanding speech in noise among NIHL subjects. It is hypothesized that exposure to noise for a prolonged period significantly affects listening effort. The study's objective is to compare the listening effort in individuals with NIHL (clinical group) and individuals with hearing loss having no significant history of noise exposure (control group).

Method:
A repeated measure research design was used to investigate the listening effort at different SNRs in clinical and control groups. A total of 40 participants with symmetrical mild sensorineural hearing loss in the age range from 40 to 50 years were sub grouped into clinical (exposed to noise in factory) and control (no significant noise exposure) groups.
Gap detection test was used to assess temporal processing ability. The task was to detect a brief pause in broadband white noise presented binaurally at the listener's most comfortable level. The minimum gap (in msec.) at which the patient identifies it is term as gap detection threshold (GDT).

The listening effort was measured at four different signal-to-noise conditions (-2,0, 2 and 4 dB SNRs) using the dual-task paradigm. The listening task comprised primary and secondary tasks. In the primary task, the last word of the heard sentence had to be repeated. In the recall task, the repeated last words of five sentences had to be recalled in free order as soon as a beep sound is heard through headphone.

Results:
Independent sample t-test revealed a significantly reduced temporal processing ability, as reflected in GDT [t (28) = 4.829, $P < 0.001$] in the clinical group than the control group.
A repeated measure ANOVA (SNRs) with between-subject factors as groups was performed for the primary task of listening effort. The result revealed a significant main effect of SNR [F (3, 114) = 196.72, p= 0.001, η^2 = 0.838] and groups [F (1, 38) = 16.09, p= 0.001, η 2 =0.298] on repeat score. Further, a significant interaction effect of SNR* group was found [F (3, 114) = 6.10, p = 0.001, η^2 = 0.138] on repeat score. Further, a post hoc analysis was performed to investigate in which SNRs, a significant difference between groups were found on a score of the repeat task. An independent samples test revealed that repeat score was significantly poorer in clinical group than control group in -2 dB SNR (t (38) = 3.66, p= 0.001), 0 dB SNR (t (38) = 5.03, p= 0.001), and +2 dB SNR (t (38) = 3.02, p= 0.004). At + 4 dB SNR, although the score on the repeat task was poorer in the clinical group than the control group, this difference failed to reach significance (t (38) = 1.10, p= 0.276).

A repeated measure ANOVA (SNRs) with between subject factor as groups was carried out on the recall score (secondary task). The results revealed a significant main effect of SNR [F (3, 114) = 114.17, p= 0.001, η ^{2} = 0.857] and groups [F (1, 38) = 39.77, p= 0.001, η ^{2} =0.511] on recall score. In addition, a one-way interaction (SNRs) with between subject factor as group was significant [F (3, 114) = 6.30, p = 0.001, η ^{2} =0.142] on recall score. Further to know in which SNR the recall score found significant between groups, a post hoc independent sample t-test was performed. The results revealed that the recall score in clinical group was significantly poorer than control group at -2 dB SNR (t (38) = 2.18, p= 0.035), 0 dB SNR (t (38) = 6.49, p= 0.001), +2 dB SNR (t (38) = 7.13, p= 0.001), and +4 dB SNR (t (38) = 4.02, p= 0.001).

Further, a significant strong positive relation between recall and repeat scores of listening effort task in both clinical (N = 80, r = 0.829, p = 0.001) and control (N = 80, r = 0.907, p = 0.001) groups was observed. It is thus inferred that the recall scores reduce with the decrease in repeat scores in each of the groups.

Discussion:

In the clinical group, temporal processing impairment is significantly high reflected in the GDT. The speech recognition and listening effort is significantly affected in NIHL group than their counterpart at reduced SNRs. The cognitive capacity allocates the maximum resource to extract the target words in a sentence as there is a likely chance of information masking (four talker babble), and limited remaining resources are used to recall the repeated words. Thus, primary (early) and recency (most immediate) words will be recalled leaving the asymptote words (between early and quickest). A neuroeconomics calculation evaluates cost-benefit analysis in a situation where demand is high, especially at reduced SNRs. Thus, in evaluating the demand on capacity during the task, feedback from the cognitive system shows displeasure and receives no reward for their task and induces low motivation. The influence of feedback evaluation allocates the cognitive resource where the intentional attention fluctuates during the task leading to more effort in listening. The correlation analysis also revealed a significant strong positive relation between recall and repeat listening scores. It indicated that the recall score reduced with the decrease in recognition score. It was seen in both groups, but it was more pronounced in NIHL group. This is because a cochlear distortion due to hearing loss in the clinical group plus the temporal processing impairment owing to noise exposure taxes the maximum cognitive capacity to allocate the resource than their age and hearing loss matched counterparts.

Conclusion:

Individuals with noise-induced hearing loss exhibit a significant temporal processing impairment that leads to effortful listening than hearing loss alone.

Waist circumference and body fat percentage are the potential indicators of cognitive performance among postmenopausal women

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Aim:
The menopausal transition is associated with alteration in the obesity measures, body fat distribution and also in the cognitive functioning of women. Thus, the major aim of the present study was to investigate the potential indicators of cognitive impairment among rural postmenopausal women of Rupnagar district, Punjab.

Methods:
A total of 207 rural women of Punjab were comprehended in the current cross-sectional study. Hindi version of Mini-Mental state examination scale was used to ascertain the cognitive status of all the participants. Receiver operating Characteristics (ROC) curve analysis was employed to discern the potential indicators associated with lower cognitive performance of the postmenopausal women.

Results:
In the current sample cognitively normal postmenopausal women (both in early and late post menopause phase) exhibited significantly higher waist circumference, fat mass and fat mass index as compared to their cognitively impaired peers. The early postmenopausal women with different cognitive status also exhibited significant difference in hip circumference and body fat percentage. The results of ROC curve indicated that in both the early and late postmenopausal women waist circumference (AUC= 0.850 and 0.667 respectively) and body fat percentage (AUC= 0.814 and 0.826 respectively) were the best indicators of lower cognitive scores.

Conclusion:
Midlife women are at higher risk of developing cognitive decline with menopausal transition and the results of the current study can be helpful in screening the condition of women vulnerable to cognitive impairment at later stage of their life.

Deep Learning Framework for Causal Connectivity based Epileptic Neuromarkers from Multi-channel EEG

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Recent research in computational neuroscience has intrigued investigation of epileptiforms to understand causation of epileptic seizures and enable early detection and prediction. The onset of seizures has been related to characteristic patterns of slow (evolving over long-term time scale) preictal changes in neurocortical excitations. The task of seizure prediction and early detection is performed by binary classification of EEG waveforms as preictal or non-preictal. Detection of a preictal epoch on time-scale within required seizure prediction (preictal) horizon (SPH) thus predicts upcoming seizure onset. In this work, visual investigation of mean PLV (also called mean phase coherence (MPC)) features related to interictal, preictal, and ictal epochs revealed distinctive patterns in various frequency bands. Further quantitative assessments of mean PLV among 6 regions of interests (ROI), selected with reference to default mode networks (DMNs), across successive epochs of epileptic EEG, showed existence of distinguishing patterns of phase coupling during the interictal, preictal, and ictal periods. Subtle distinctive patterns of connectivity among specific ROIs in gamma band and beta bands were found. This contrasts with the traditional emphasis on excitation coupling among specific DMNs in gamma band. Considering the algorithmic aspect, the proposed pipeline employs PLV's novel formulation which is faster than traditional implementations. MPC quantifies the instantaneous phase difference of two signals which are 'locked' or evolving together in case of an event if the measure is constant for the period. To compensate for the noise and chances of the signals carrying effects of multiple oscillators, instead of assuming constant differences, connectivity is estimated in terms of the distribution of phase differences. A higher PLV/MPC is linked to narrower distribution of the phase difference and hence higher phase dependence. Dynamic thresholding of the connectivity measure was applied to conduct classification on the basis of significant causal connectivity features only.

Deep learning models for seizure classification using raw EEG input have been found to perform better than classical machine learning based models, which employ hand-crafted features e. g. in frequency domain and require intensive pre-processing for handling artifacts and non-stationarity. Power of CNN to learn from such connectivity patterns amidst noises have been harnessed in this work to perform classification task. A lightweight CNN containing lesser number of layers avoids overfitting and reliably classifies pre-ictal patterns versus the inter-ictal patterns. The proposed 3D-Convolutional Neural Network 2 (3DCNN), termed ConNet, is a shallow network, which avoids overfitting and consumes lesser time as compared to the baseline model LeNet. Class imbalance is handled by data augmentation method. On training and validation with input feature matrices of dimension 6x6x3 each, taken from single subject data, validation accuracy of ConNet was found to be 98.8% as compared to 95.6% of the baseline LeNet model. Further test runs of the proposed model with data from 10 subjects separately, resulted into average accuracy, sensitivity, specificity as high as 99.4%, 98.8%, 98.7% respectively, and average FPR as low as 3.8%. The epileptic EEG-scalp dataset available from the MITPhysioNet website (https://physionet.org/content/chbmit/1.0.0/) was used in this study. Contributions include the following: (a) Novel pipeline has been employed. First, automized minimal pre-processing step excludes the explicit processing for removal of artifacts. Faster implementation of Mean PLV values adopted to extract feature matrices from raw EEG signals in three different frequency bands. Subsequent step is to train a shallow 3DCNN (ConNet) which classifies preictal versus interictal patterns. Identification of preictal pattern is interpreted as prediction of upcoming seizure. (b) Computational requirement has been considerably reduced as compared to baseline classifier. (c) The class imbalance inherent in the dataset has been addressed using suitable data augmentation scheme. (d) Training and validation performance of ConNet is found to be better in terms of accuracy, sensitivity, specificity, and false prediction rate.

Keywords:
Multichannel connectivity based neuromarkers, Early epilepsy detection, 3D Convolutional Neural Network (CNN), Phase Locking Value (PLV)

A Review on Icariin: A Promising Perspective for Future Application in Parkinson's Diseases

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Neurodegenerative diseases (NDs) are now the leading source of disability globally. Among NDs examined in the Global Burden of Disease, Injuries, and Risk Factors Study (GBD) 2015, Parkinson's disease (PD) was the fastest-growing prevalence, disability, and death. Over history, diseases have appeared and disappeared or have increased/decreased in frequency, but the number of individuals with Parkinson's disease globally has doubled to over 6 million. PD is a chronic neurodegenerative disease related to the dysfunctions of nigrostriatal dopaminergic systems that affect motor skills and cognitive performance. The pathological hallmark of PD is the formation of alpha- synuclein containing Lewy bodies in midbrain dopaminergic neurons and other mechanisms such as age-related excessive oxidative stress, leading to neuroinflammation, DA auto-oxidation. Reducing alpha-synuclein pathology is a major food of preclinical research. Several molecules have been proposed as potential treatments. However, none of them has been conclusively demonstrated to reduce degeneration. There's currently no cure for PD. Still, treatments are available to help relieve the symptoms and maintain quality of life like L-DOPA remains the gold standard effective drug therapy for PD. Still, it's long-term use leads to many complications and severe side effects. It is estimated that the number will be more than double by 2030 to between 8.7 million and 9.3 million. With such a large number of PD patients worldwide and no permanent cure are available so there is an urge for the better therapies and medications opens the gate of immense research in this field to provide better insight for new chemical entity and their functioning. Thus, understanding the mechanisms underlying PD process and developing the effective inhibiting therapeutic approaches to halt the progression of PD is of paramount significance. Exploring for achieving novel compounds with therapeutic benefits in PD patients is the focus of many current investigations. Amongst them, one such compound is Icariin.

Icariin belongs to the class of flavonoids and is a bioactive component of Epimedium sagittanum (traditional Chinese herb), also known as Horny Goat Weed. It has been known to exert anti-oxidative, anti-neuroinflammatory, and anti-apoptotic effects via several relevant pathways, including insulin-like growth factor (IGF), transforming growth factor-B synthase (NOS), and others. Investigations on neuroprotection are at the forefront of PD research. The shreds of evidence presented by many studies have demonstrated that Icariin attenuated LPS/6- OHDA-induced dopamine neurotoxicity and glia cells-mediated neuroinflammatory responses via activation of Nrf2 signalling pathway in glial cells. It has been assessed that Icariin protects against MPTP-induced dopamine neuronal damage by regulating PI3K and MEK signalling pathways. Additionally, studies have indicated that Icariin improved spatial learning and memory abilities in lipopolysaccharide (LPS)-induced rat brain dysfunction by inhibiting LPS hippocampus IL-18 and cyclooxygenase-2 (COX-2) expressions. Co-administration of Icariin significantly attenuated neurotoxicity and improved mitochondrial function in rats treated with Rotenone. Some findings have suggested that Icariin might be a potential promising adjuvant to enhance L-DOPA efficacy and attenuate L-DOPA-produced adverse effects in PD. Therefore, to verify the translational value of Icariin, these combination treatment needs to be rigorously corroborated in other PD animal models. Despite great progress in understanding the pathogenesis, intervention, and treatment of PD remain a big challenge. Several lines of evidence confirm that icariin might hold promising therapeutic properties on PD. Therefore, the final thought on Icariin is that it might hold promising therapeutic properties on PD and thus need to be rigorously confirmed in human studies.

Keywords:
Parkinson's disease; Icariin; Alpha-synuclein; Lipopolysaccharides; 6- hydroxydopamine

Cerebellum Model Circuitry Explaining Knockout Behavior of Purkinje Neuron during Movement Disorder

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Mathematical models and numerical simulations can be used to accurately predict the behavior of neurons during normal and diseased conditions. Movement disorders including autism spectrum disorder (ASD) are associated with several symptoms including impaired social interactions and communication, repetitive behavior, and trouble with verbal and non-verbal communications (Hodges et al., 2020). The nonlinear neuronal properties related to these symptoms can be represented by mathematical models, which highlight the effect of neuronal activity of a single cell in a large network. This study employs a large-scale 3D spiking neuronal network of the cerebellum to model the behavior of neurons due to PTEN knockout (KO) in a Purkinje cell (PC), which is responsible for the development of ASD-like traits. We used an Adaptive Exponential integrate and fire neuron (Adex) (Naud et al., 2008) model of cerebellum single neurons including granule cell, Golgi cell, Purkinje cell, inferior olivary and molecular interneurons such as basket and stellate cells, and these neurons, which was adapted from previous study (Medini et al., 2014) were connected synaptically based on their convergence-divergence ratio (Solinas et al., 2010). Since the spiking neuron model lacks spatial properties, morphological characteristics of cerebellum neurons during ASD were not able to be incorporated into the study. The current model showed the electrophysiological characteristics of PC, and a combination of parallel fiber-PC, and climbing fiberPC synapse disruption. The model also reconstructed the apoptotic behavior of the network as seen in the PTEN KO experiment (Cupolillo et al., 2016). Abnormal signalling in PTEN mutant mice have been modelled by fine-tuned interspike interval (ISI) and PTEN induced apoptosis (Kyrylenko et al., 1999) with respect to the age of mice. Previous study has shown that the thickness of the molecular layer of the cerebellum was increased in PTEN KO mice at 2 and 4 months of age [3]. In this model, the behavior was modelled by increasing the number of molecular layers of Basket (BC) and Stellate (SC) cells. These behaviors lead to an increase in input resistance of the PC. Therefore, eventually the excitability of PC will decrease which could trigger cell death. The results indicated that the spontaneous firing of PCs has reduced with an increased ISI of 65.61+-8.01 ms. The latency of the first spike of PC during ASD is increased and the overall excitability of PC was reduced when the thickness of the molecular layer increased. The firing deficits are frequently followed by PC loss, directing to further upswing of behavioral abnormalities (Cook et al., 2021). This model can also represent the connectivity realistically and its architecture is scalable, which evaluates the population activity and predicts the complex spatiotemporal patterns in network activity.

Keywords:
Cerebellum, Autism Spectrum Disorder, Purkinje cell, Mathematical Model, Computational Neuroscience.

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Stability of sensorimotor network sculpts the dynamic repertoire of resting state across age

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Introduction:
Aging is typically associated with substantial structural and functional modifications of the brain. Significant number of studies which have investigated age-related modifications in functional networks using static functional connectivity reveal, an overall increase in between network connectivity and decrease in within network connectivity in older adults. Recently, dynamic functional connectivity (dFC) has emerged as a major topic in the resting-state BOLD fMRI literature. Despite the dynamic nature of functional connectivity (FC), stable representation of neural activity in brain's functional architecture is critical for survival. FC stability has been shown to increase with motor learning, decrease in patients of schizophrenia and their siblings and was significantly higher in patients with major depressive disorder. Although previous studies have explored the association between dynamic functional connectivity and age, how the stability of functional architecture modifies across lifespan ageing remains an open question. This study investigates the modifications in temporal stability of resting state/ task functional architecture with a novel data-driven unsupervised method across life span ageing.

Dataset:
The Cambridge Centre of Ageing and Neuroscience (Cam-CAN) is a large collaborative multimodal life span population-based study. Cam-CAN fMRI raw datasets of resting state, passive movie watching, and sensory motor task (smt) of N=645 participants (aged 18 – 88 years), were pre-processed and time series were extracted using AAL^3 parcellation. In order to capture the pattern of temporal stability over lifespan (e.g.: of the 'Entropy' metric), we divided the whole dataset of N=645 participants into non-overlapping bins of 5 years starting from 18 years. On the other hand, to gather accurate insights in each stage of the adult lifespan, we divided the whole data of N=645 participants into three cohorts, young adults with an age range 18-40 years (50.27 % female; mean age=31.21±6.06 years), middle adults with an age range 41- 60 years (52.23% female; mean age = 50.49±5.70 years), old adults with an age range 61-88 years (49.92 % female; mean age = 73.72±7.20 years).

Results:
We developed a novel data-driven unsupervised method to estimate temporal stability of dFC where – we obtained dominant dFC subspaces by applying PCA to BOLD timeseries at each timepoint, reconstruct either the task or rest as the dynamics of a reduced dimensional dFC subspace and estimate temporal stability using angular/Mahalanobis distance and investigate ageing related changes in temporal stability of FC across resting-state, movie-viewing and sensorimotor task

Figure 1: Temporal stability differences in dFC across healthy ageing in rest/ task - using angular distance

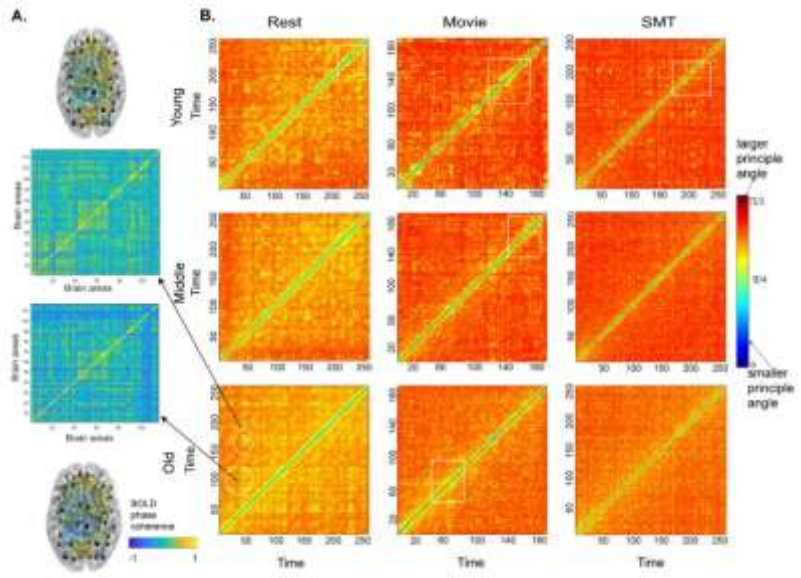

Figure 1B shows the Time X Time temporal stability matrix of resting state, naturalistic movie watching task and discrete, sensorimotor task for young, middle and old adults. Each entry in the matrix is the principal angle ϕ (t_x, t_y) between dominant dFC subspaces at t_x and t_y. The principal angle ranges between 0 (low angular distance) to $\pi/2$ (high angular distance). A global spread of shorter duration of temporal stability patterns was observed in resting state and local spread of longer duration temporal stability patterns was observed in the task, in all young, middle and old adults.

Figure 2: Temporal stability differences in dFC across healthy ageing in rest/ task - using Mahalanobis distance

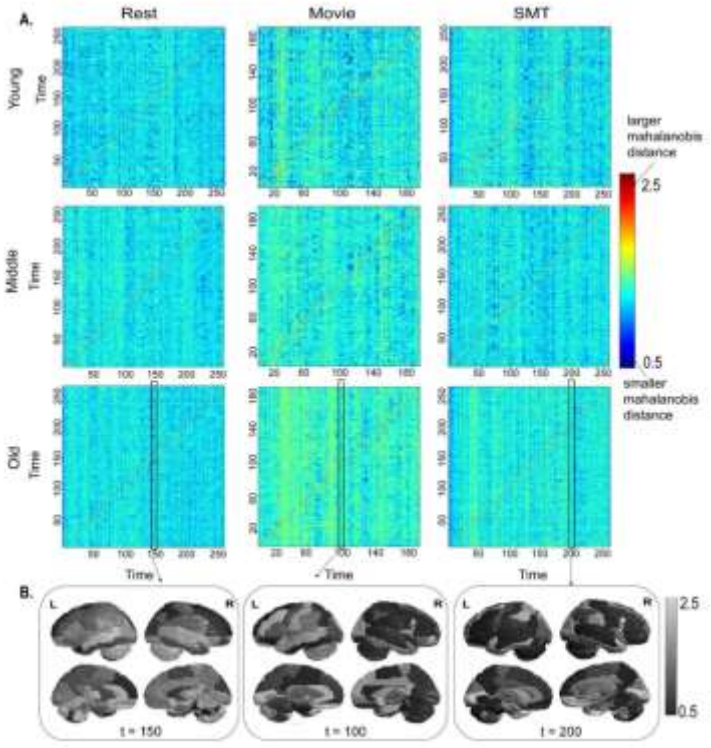

Figure 2 shows Time X Time temporal stability matrix of resting state, naturalistic movie watching task, and sensorimotor task for young, middle and old adults, where each entry in the matrix is Mahalanobis ($M2$ (t_x, t_y)) distance between the dominant dFC subspaces. Mahalanobis distance between dominant dFC subspaces is low when the dFC configurations are similar. Resting state, in young, middle and old adults, has shorter-lived, global spread of patterns of temporal stability. On the contrary, both the tasks have a longer-lived, local spread of patterns of stability.

Figure 3: Peak temporal stability of dFC in sensorimotor task, followed by passive movie watching and resting state across life span ageing

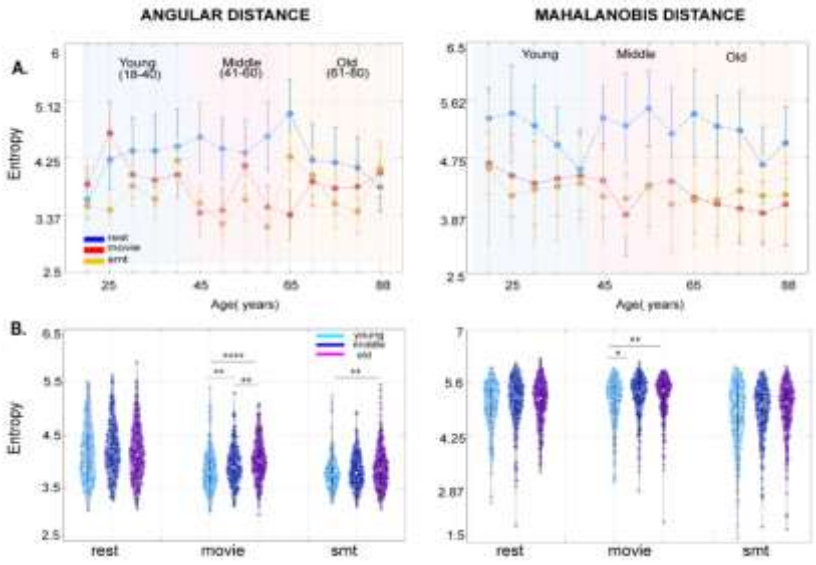

Figure 3 represents entropy of temporal stability matrices of resting state (rest), naturalistic movie watching task (movie) and sensorimotor task (SMT) across lifespan, for Angular distance and Mahalanobis distance metric. In **Figure 3A**, to capture the temporal stability patterns over the lifespan, the subjects were divided into non-overlapping bins of 5 years starting from 18 years to 88 years (18-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56- 60, 61-65, 66-70, 71-75, 76-80, 81-88). Our entropy results indicate the stability of functional connectivity architecture was highest in the discrete, goal-oriented sensorimotor task, followed by continuous naturalistic movie watching task and resting state. Subsequently, to gather insights at each stage of adult lifespan, we divided the total N=645 subjects into three age groups -Young, Middle and Old with sufficient number of participants (> 180) in each category **(Figure 3B)**. Entropy analysis revealed, in movie watching and sensorimotor task, a peak entropy in older adults, followed by middle and young adults. Whereas in resting state, we observed peak entropy in middle adults, followed by older adults and their younger counterparts – a characteristic U-shaped trajectory.

Figure 4: Dynamics of whole brain resting state is primarily influenced by stability of sensorimotor network across lifespan ageing

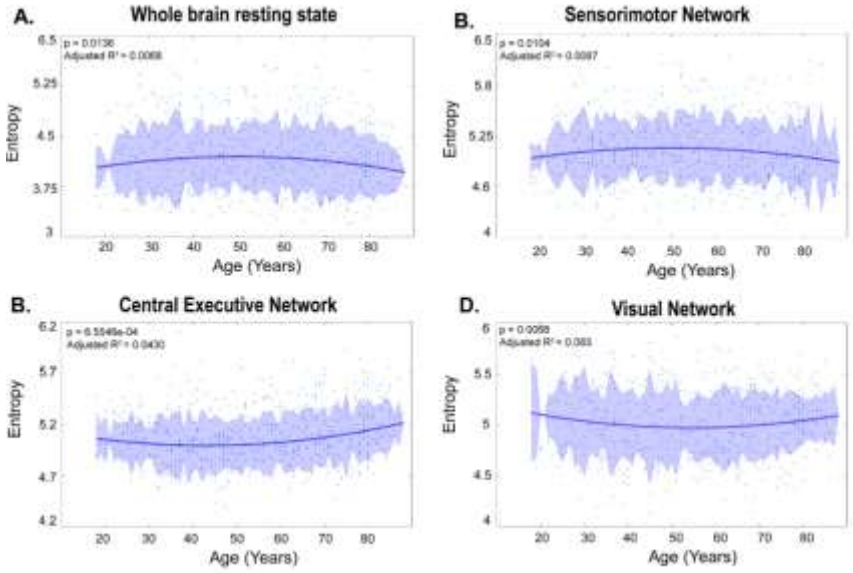

Figure 4 shows age related changes in temporal stability of dynamic functional connectivity subspace of whole-brain resting state **(A)**, sensorimotor network **(B)**, central executive network **(C)** and Visual network **(D)** estimated with angular distance metric (we show only significant networks). We estimate entropy to capture lifespan ageing specific changes in temporal stability of dominant dFC subspaces across resting state networks. Our results demonstrate significant decrease in temporal stability of central executive network (CEN) and, Visual networks in older adults. Whereas, the temporal stability of whole-brain resting state dFC and sensory motor network significantly increased with age. Of the five resting state networks, we find stability dynamics of whole-brain resting state closely follows that of sensory motor network with age.

Development in a Homosexual's Experiences: Childhood Encounters of Gay Individuals.

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The aim of this study was to highlight the childhood experiences in the developmental stages of the life, of gay men. Although homosexuality has been studied vastly by multiple disciplines over a century; yet, very few of them have emphasized upon gay men specifically from a particular geographical area. Eight men identifying themselves as gay were chosen for this study. A semi structured interview procedure was used for the data collection and the analysis was done using a thematic-narrative approach. Six major themes were identified as a result of a 40-60 minutes interview with each participant. These were: (1) The Beginning – Realization of Sexual Preferences, (2) Expression – The Coming Out Process, (3) The Reactions of Others – Acceptance/Rejection, (4) Interpersonal Relationships, (5) Struggles in day-to-day life and, (6) The General Outlook – Attitude towards the social world.

Keywords:
Homosexuality, sexual abuse, rejection/acceptance, romantic relationships, identification, thematic, social factors.

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Modelling neural activity dependent vascular changes in cerebellar granular layer

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Human brain being the most metabolically active part of the body, requires continuous supply of nutrients and oxygen through local blood vessels. Reconstruction of neural activity dependent local blood vessel diameter changes in the brain has not been explored much due to complex interaction between the parameters and the heterogeneous behaviour (Zhang et al., 2019). Changes in vessel diameter controls the local cerebral blood flow and thereby controls the supply of nutrients and oxygen required to the particular region that is active (Fantini et al., 2016). In neurons, synaptically released glutamate induced N-methyl-d-aspartate receptors (NMDARs) activation leads to Ca2+ influx, causing the release of nitric oxide (NO) from neuronal nitric oxide synthase (nNOS), which activates smooth muscle guanylate cyclase (Rameaut et al., 2004). This in turn generates cyclic guanosine monophosphate (cGMP) to dilate arteriolar blood vessels (Sandoo et al., 2010). From the previous studies, it was evident that regulation of cerebral blood flow occurs at the level of arterioles, leading to dilation (MacVicar & Newman, 2015). In this study we developed a mathematical model to describe the visco-elastic mechanical behaviour of the arteriolar wall radius changes in cerebellar granular layer, in accordance with neural activity dependent NO concentration changes. NO can lead to vasodilation/constriction of arteries by indirectly influencing the smooth muscle cell (SMC) contractile system that mediates the formation of cross bridges within actin - myosin filaments (Brozovich et al., 2016). Rate of change of NO concentration in SMC was modelled as the sum of diffused concentrations from the neuron using first order differential equations. Detailed multicompartmental biophysical granule cell model with 52 active compartments was used to understand the cerebellar neuro vascular coupling particularly in the granular layer (Diwakar et al., 2009). Our mathematical model could effectively simulate arteriolar responses to neuronal activation providing varied synaptic inputs. We have considered the cerebral artery to be an idealized thick – walled cylindrical vessel with uniform material properties determined experimentally by (Dormanns et al., 2016). Results demonstrate that NO leads to a general increase in blood flow with predominant neuronal excitation and arteriolar vasodilation. Furthermore, arteriolar radius changes were observed by increasing the levels of cGMP in SMC. It could highlight that NO acts as a major vasodilatory agent and could significantly influence NVC mechanism. Arteriolar dilation and blood flow changes was directly observed on a same temporal scale with respect to neural activity. As a bottom-up modelling approach this study can connect NO concentration changes to neural activity and to physiological relevance of BOLD responses in cerebellar micro zones and other circuits.

Keywords:
Neurovascular coupling, Mathematical modelling, Nitric oxide, Cell signalling, Smooth muscle relaxation, Arteriolar radius.

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Effects of early abstinence on cognitive functions in alcohol-dependent patients

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Introduction:
Alcohol dependence is associated with various significant cognitive dysfunctions like attention, working memory, speed of processing, visuospatial abilities, executive functions and verbal fluency during both short as well as long-term abstinence. The purpose of this secondary analysis of data from clinical trial was to study cognitive functioning of individuals with alcohol dependence during early abstinence.

Materials And Methods:
44 adult males in patients with alcohol dependence (ICD10) who had completed a course of detoxification and who did not have any withdrawal symptoms (CIWA-Ar Score= < 7) were recruited for this study. First Neuropsychological Assessment of the sample was done at completion of alcohol detoxification and second Neuropsychological Assessment of the sample was done one week apart for 7 cognitive domains namely Mental Speed, Category Fluency, Working Memory, Response Inhibition, Visuo-Spatial Construction, Visual Learning and Memory and Verbal Learning and Memory using Digit Symbol Substitution Test, Animal Names Test, Verbal N Back Test, Stroop Test, Complex Figure Test and Auditory Verbal Learning Test. Dependent t-test for paired samples was used to analyze the data.

Results:
The patients exhibited improved cognitive functioning in terms of Verbal Learning, Category Fluency, Mental Speed, Response Inhibition, Visuo-Spatial Construction and Visual Learning and Memory at post assessment. However, no significant recovery was seen in the cognitive domains of Verbal Memory and Working Memory.

Conclusion:
Findings of this analysis show that some cognitive dysfunctions are transient and recover in early abstinence after one week of detoxification. However, a few cognitive domains like that of Verbal Memory and Working Memory did not show any improvement in early alcohol abstinence. It reflects that abstinence from alcohol can lead to improvement in cognitive functions but few cognitive domains may require longer period of abstinence from alcohol to recover. Clinicians should consider early interventions to target these cognitive domains since significant normalization of these cognitive functions may help patients to learn, retain and apply the programs such as ways of coping with craving, distress and more constructive problem-solving strategies during the initial phase of abstinence and help in relapse prevention.

Key words:
Cognitive function, Alcohol Dependence, Abstinence

The Perception of Abstractness of Concepts

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Introduction:
In Elementary school, we learnt that words like "apple" are called common nouns and words like "democracy" are abstract nouns. Coming up with complicated abstract words is peculiarly characteristic to human beings. It lets us think of "capital" and "secular," allowing a complicated imagination of social structures and relations. The Classical definition of abstractness defines it as those concepts which are not directly perceivable through our five senses. Despite this being the accepted and a fairly straightforward definition, significant variation has been observed in the perception of abstract and concrete concepts.
Classical theories postulate separate, differentiable mechanisms for processing abstract and concrete words (Paivio, 1991; Nopeney and Price, 2004; Shallice and Cooper, 2013). According to these theories, abstract and concrete words form a non-intersecting binary based on physical referencing. Concrete words have single material referents in the world, whereas abstract words do not have material referents. An alternate group of theories suggest overlapping mechanisms without a clear, fixed distinction. They suggest that both kinds of concepts are grounded in sensory-motor information, where concrete words have a higher percentage of direct sensory-motor grounding than abstract words. Along with physical referents, both concepts are grounded in experience, situation knowledge (Barsalou and Weimer-Hastings, 2003), emotions, social cognition, internal and mental states (Troche et. al., 2014, 2017; Wiemer-Hastings, 2005; Binder et. al., 2016; Borghi et. al., 2018). This means that while, abstract words and concrete words have different ratios of grounding areas they are both represented by the same mechanisms resulting in a spectrum view of abstractness and concreteness.

This representation has largely been studied through recall and memory tasks, semantic analysis of Property Generation Tasks, language and neuroimaging of comprehension. There are relatively few studies which directly ask participants to rate words on abstractness and concreteness using the Classical definition. These studies have found that abstract and concrete have significant difference between them, but contain significant variation within the clusters (Wiemer-Hastings et. al., 2001; Harpainter et. al., 2018). This work examines i) the variance between concepts ii) conducts a cross cultural comparison of the perception of abstractness.

Stimuli Selection:
Words were selected from three publicly available wordlists: i) Van Dantzig et. al., 2011 containing property and object words; this list had been created to study modality specific experience ii) Harpainter et. al., 2018 containing abstract words. This list had been created to study the concept content of abstract words and contained modality specific content frequencies. iii) Lenci et. al., 2013 containing verbs, nouns and actions. This list had been created to study differences in concept content between sighted and blind participants. From these three wordlists, 80 words were selected on familiarity, abstractness and grounding in visual, auditory, tactile modalities, internal state and emotion and verbal association.

Method:
These words were randomly presented to 15 participants (female = 6), aged between 21 and 26 (SD = 1.95). The upper limit of 80 was selected based on three trial runs where two rates were given 100, 80 and 75 words to test for exhaustion. The rating task used audio files of the words.
The experiment was conducted completely online on Pavlovia. The experiment was an auditory experiment where participants were presented audio files of the words. This task design was selected keeping in mind a future study with blind participants to study the effect of modality specificity in conceptual processing. Participants rated familiarity and abstractness of words that they heard on 5-point Likert Scales.

Results and Discussion:

We observed that there was significant difference in mean rating of abstract and concrete words (Wilcoxon coefficient = 660, p = 1.403e-09) consistent with previous results. Also consistent with previous studies, there was high variance (var. = 1.150) between the two kinds of concepts. The ratings showed high variation in the individual rating of abstractness (avg. var = 1.277) of words, implying a level of subjectivity in the perception of abstractness. Furthermore, the ratings had more "confusion" for abstract words than concrete words. The average variance for concrete words was 0.663, and the average variance for abstract words was 1.675. The deviation and heterogeneity of ratings are observed to increase with the level of abstraction, with only the highly familiar group of words (rating = 1) not having a lot of deviation. The comparison of abstractness ratings between ratings from the wordlists and an Indian population revealed a significant difference (Wilcoxon coefficient = 4911, p = 3.063e-08) suggesting a role of cultural differences in the perception of abstractness.

These findings raise the question that if the classical definition of abstraction and concreteness is robust enough, why is there so much variation that is observed? Understanding the mechanisms involved in the representation of abstract and concrete concepts is paramount to understanding the mechanisms involved in knowledge representation. Furthermore, whether concepts are represented as binary or in a spectrum underlies the objective A modal Symbol System representation of concepts and the Embodied representation of concepts which emphasises subjective experience (Barsalou and Weimer-Hastings, 2003a; Borghi et. al., 2018). Our findings question the "objective" Classical definition. A possible explanation for this variation is that we do not experience all objects in equal frequencies. Some parts of the world, terrains and cultures experience certain objects more frequently, like apples in Africa vs apples in Washington, which could influence the perception of abstraction based more on experience rather than the actual perceptibility

Development of Cognitive retraining module for improving cognitive deficits of abstinent patients with Alcohol Dependence Syndrome, Cannabis Dependence Syndrome and Opioid Dependence Syndrome in a Tertiary Care De-addiction Centre of Northern India

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Introduction:
Substance abuse is a widespread problem with negative social and economic implications. Many abused substances, particularly alcohol, cannabis, and opioids, have been found to be hazardous to human health. These chemicals have an impact on cognitive functions, causing problems with activities of daily living (ADL), problem-solving, planning, motivation, attention and concentration, memory, and so on. Given a large number of chronic abusers and dependent on such substances in our nation, cognitive deficits are anticipated. Some studies have found that even after a significant period of no intoxication symptoms, many patients have obvious deterioration of cognitive processes.
Despite significant evidence of cognitive deficits linked with substance use and several articles utilizing cognitive job training programs for drug addictions, there are only a few well-structured and planned methods to enhance cognitive capacities in substance users. Thus, the current study is an attempt to design and assess an effective cognitive retraining module for those suffering from Alcohol Dependence Syndrome (ADS), Cannabis Dependence Syndrome (CDS), and Opioid Dependence Syndrome (ODS).

Methodology:
A purposive sample of 150 male participants in the age range of 20-50 years (50 in each group) was selected from NDDTC (National Drug Dependence Treatment Centre), AIIMS. Cross-sectional research was carried out on 50 abstinent males in each group of ADS, CDS, and ODS with cognitive deficits on different neuropsychological tests including digit repetition test and random letter test to assess attention, PGI memory scale to assess memory, Wisconsin card scoring test, Animal's name test and N-Back test to assess executive functioning and Koh's block design test to assess Visio-spatial ability.
Development, assessment of feasibility, and evaluation of the cognitive retraining module through a pre-post design.

Patients who completed baseline assessment underwent 6 sessions of cognitive retrainingbased intervention which was held once every 2 weeks. The cognitive retraining module was applied, in which patients were psycho-educated about illness, associated cognitive deficits, and the role of deficits in treatment outcome, cognitive retraining, and efficacy of the intervention. In each session, they were explained cognitive retraining tasks and that task was also practised during the sessions. Thereafter, they were provided with specific homework tasks to practice at home and for that reason, they were given proper guidance and retraining related material to use for practicing at home. They were allotted easier tasks first, and then the difficulty level of the task was increased in subsequent sessions. Thereafter, in the end, a post-assessment was carried out.

Results:
The demographic factors including age, religion, occupation, family type, residence, socioeconomic status, and marital status were compared across three groups: ADS, CDS, and ODS. According to the data, more than half of the patients had high school education, 55% were married, the majority (67%) were Hindu, 68.61% were employed, 60% lived in a joint family set up, all of the participants lived in urban areas, and more than half were from a middle socioeconomic status.
The findings of the comparison of cognitive domain impairment of ADS group participants for pre- and post-intervention revealed that PGI digit span ($W=2.38$, $p=0.05$), PGI retention for dissimilar pairs ($W=2.06$, $p=0.05$), and PGI recognition ($W=0.51$, $p=0.05$) were found to be significantly different. Digit

vigilance time (t=5.08, p=0.001) and digit vigilance error (t=3.54, p=0.001) were found highly significant when comparing pre- and post-intervention. Executive functioning was compared between pre- and post-intervention and found each component was significantly different except 'perseverative error t-score pre', and 'no perseverative t score pre'. Moreover, n-back1 (t=3.79, p=0.001), n-back2 (t=4.45, p=0.001) Animal test (t=3.70, p=0.001) and Koh's block test (t=3.70, p=0.001) were also significantly different between pre and post-test.

Findings of the comparison of cognitive domain impairment of CDS group participants between pre- and post-intervention revealed that PGI delayed recall (W=3.06, p=0.001) and PGI digit span (W=3.20, p=0.001) were found to be significantly different at p<0.001 level in the group of ADS participants. Digit vigilance errors (t=4.85, p=0.001) were found highly significant while comparing pre- and post-intervention. Executive functioning was compared between pre- and post-intervention and found each component was significantly different except 'perseverative error standard score pre'. Moreover, n-back test 2 (t=7.44, p=0.001) and animal test (t=6.19, p<0.001) and Koh's block test (t=5.51, p<0.001) were also significantly different between pre and post-test.

Results show a comparison of cognitive domain impairment of ODS group participants between pre- and post-intervention. Findings revealed that the difference between pre and post across all the domains of PGI memory are statistically significant except PGI Remote memory in the ODS group. The difference between pre- and post-intervention on Digit vigilance time (t=4.74, p=0.001) and digit vigilance error (t=2.18, p=0.05) were found statistically significant. Executive functioning was also compared between pre and postintervention and found each component was significantly different except non-perseverative t scores and WCST non-perseverative S score'. Moreover, n-back1 (t=2.51, p=0.01), n-back2 (t=5.51, p=0.001), Animal test (t=3.46, p=0.001) and Koh's block test (t=2.61, p=0.05) were also significantly different between pre and post-test.

Discussion:

In India, the prevalence of substance abuse is spreading at an alarming rate. The consumption pattern varies from consumption to abuse and dependence. According to studies, the deterioration in cognitive functioning remains even during the withdrawal or abstinence period. The goal of this study was to compare the cognitive deficits of patients with ADS, CDS, and ODS, and develop a cognitive retraining module for such people and evaluate its practicality and acceptability, and analyzes its outcomes. The cognitive domain impairments in the ADS, CDS, and ODS groups were compared before and after the intervention. Only three domains in the PGI memory test, namely digit span, retention for dissimilar pairings, and recognition were observed to change significantly at the pre and post-levels. Except for perseverative error t score and non-perseverative s score, all other domains in digit vigilance, WCST, Koh's block design test, N-back test, and Animal Test were found to be significantly different. A significant difference was reported in all areas except mental balance and recognition in the PGI memory test, non-perseverative t and s score in WCST, and N-back test-1 in the CDS group. Similarly, in the ODS group, all domains in the PGI memory scale and non-perseverative t and s score did not differ substantially except for remote memory and recent memory. This suggests that the intervention had the least impact on the ADS group. In this group, only a few domains of the PGI memory test could be improved. In both the CDS and ODS groups, cognitive retraining had no effect on the non-perseverative area of the WCST.

Conclusion:

Substance abuse can hamper the cognitive functioning of an individual. Therefore, the cognitive retraining module should be encouraged to ameliorate the negative impact of substance abuse.

Computational Modeling of Neurovascular Coupling and fMRI BOLD Correlates of Neural Circuits using BOLDsim

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Functional magnetic resonance imaging (fMRI) Blood oxygenation level-dependent (BOLD) signal has been used to detect functional changes in human brain and provides an indirect measure of neural activity associated hemodynamic changes. Mathematical modeling of hemodynamic responses aims to reconstruct vascular changes when the stimulus was on, and the subsequent response return to baseline activity, once the stimulus was off (Yacoub et al., 2006). In this study, we have proposed a hemodynamic model as a tool within the dynamic causal modelling framework called BOLDsim, a NEURON based script for modeling BOLD, cerebral blood volume (CBV) changes from biophysical models of single neurons and population of neurons. BOLDsim tool interface was created using NEURON's built-in graphical components, which allow users to view the neural activity, BOLD, CBV changes along with morphology view window. Inserting "BOLDsim.mod" file into the neuron model helps to compute neural activity dependent BOLD, CBV changes from biophysical neurons. The employed hemodynamic model was a combination of Balloon and Windkessel models made with a set of ordinary differential equations estimating various biophysical parameters that are related to fMRI BOLD (blood oxygenation level dependent) signal and CBV (cerebral blood volume) changes. The governed parameters are the BOLD response y(t), blood flow (fin), total cerebral blood volume (V), total deoxyhaemoglobin (q) and E oxygen extraction fraction (Friston et al., 2003; Kong et al., 2004; Nutakki et al., 2016). The simulation was modelled to contain the hemodynamic response function and it computed the physiological and biophysical BOLD responses by using the neural activity from neuron or circuit models. Using a computational model of a cerebellar granule neuron (Diwakar et al., 2009) and a circuit model of the olfactory bulb (Davison et al., 2003), BOLDsim was evaluated with different firing frequencies. Since the blood flow and synaptic activity were inter related (Logothetis, 2008), the modelled flow to volume and BOLD responses in the cerebellar cortex expressed a seemingly linear relationship to stimulus duration. The temporal mismatch between blood flow and blood volume changes (delayed compliance) was incorporated into the model with an exponential function estimating its temporal evolution using volume and blood flow measurements (Yacoub et al., 2006). During increased neural activation the arterial compliance increases blood flow and helps in more dilation (Huneau et al., 2015). In order to test whether the measured blood flow responses were consistent with measured neural activity in the model, we used reconv (Diwakar, 2011) the neural activity with BMWM (Balloon-modified Windkessel model) (Buxton et al., 2004; Friston et al., 2000) and found that the physiological parameters including compliance matched the duration of BOLD and CBV responses with the stimulus. In the modeling, an increase in CBF (cerebral blood flow) led to an increase in amplitude changes of BOLD, CBV responses with respect to corresponding change in the local neural activity. With the emergence of bottom-up reconstruction of connecting neural activity to fMRI BOLD and CBV responses, fMRI with other imaging signals and similar population responses can be modelled to apply on healthy and diseased conditions as emergent properties in underlying neural circuits.

Keywords:
BOLD (Blood oxygenation level dependent) signal, CBV, CBF, Neural Activity, Mathematical model

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Visuo-locomotive Update in Naturalistic Navigation: Multimodal analysis examining the role of familiarity and rotational locomotion

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Spatial (memory) update strategies depend on situational factors, such as availability of external information, familiarity with the environment, and cognitive demand. Of key interest to this research is the multimodal integration of environmental and individual characteristics in visuospatial update and reorientation in situations of extensive (embodied) rotational locomotion in naturalistic conditions. We investigate active visuo-locomotive experience and reorientation performance in everyday navigation in natural urban settings.

We examine navigation and update strategy adaptation in relation to familiarity, the difficulty of the task (as articulated via a ``rotation metric´´), and available external visuospatial cues. In two behavioral studies in large-scale built environments, two healthcare facilities and a train station, 45 participants (aged 18-83) performed a navigation task under natural conditions. A multimodal analysis of visuo-locomotive behavior was conducted including eye-tracking, video analyses, sketch-mapping task, orientation pointing task, and post-questionnaires.

In the first study conducted in two healthcare facilities, namely the Old and New Parkland hospitals in Dallas (USA), 25 participants were asked to find their way in an unfamiliar environment. We focused on an average of 2 events of confusion or disorientation per participant throughout the route. The environmental analysis of the path reveals correlations between the disorientation events and the visuospatial characteristics of the path at key locations and decision points. Three key results were reported after the combination of the behavioral and the environmental analysis: (1) visual accessibility at key locations (e.g., intersection, entrance hall, atrium lobby) of the path towards manifest cues (e.g. signages, landmarks) and environmental cues (e.g. geometry, symmetry) is critical for better navigation performance and reduced numbers of confusion events, (2) narrow enclosed spaces have a negative impact on navigation experience, (3) extensive ego-rotations, defined as rotation metric of the path, influence orientation performance.

In the second study, we further explore the impact of rotations in navigation performance, and the reorientation strategies used actively during the navigation task at a train station in Bremen (Germany); the task is a part of a typical everyday commuting scenario. More than 60% of the participants experience a confusing event, especially while performing 360-degree ego-rotation. The multimodal analysis also suggests that the level of familiarity is related to the choice of navigation-aids used for reorientation (between environmental cues, and manifest cues) and the timing where these strategies were adopted. Results suggest that familiar navigators rely on environmental cues and exhibit proactive decision-making, whereas unfamiliar ones rely on manifest cues, are late in decision-making, and show no sign of sensorimotor spatial update. Moreover, the visual attention analysis shows that the direction of movement affected the gaze close to the decision points, and the extent of rotation negatively affected the spatial update performance.

Active locomotion where a full-range of combined perceptual and cognitive processes are involved suggests that subjects do not demonstrate spatial updating strategies based on spatial representations, instead explicitly relying on external visuospatial cues. However, the extent of rotational locomotion, the visual accessibility to navigation-aid cues (e.g. signage, landmarks), and the level of familiarity play a fundamental role in the choice of the updating strategies people use for effective reorientation. Next steps of our research involve embodied navigation behavioral studies in virtual environments (VR) where the conditions of the rotation angle tested and the positioning of cues can be systematically manipulated to provide a metric for the extent of which they influence navigation performance.

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Implementing Web-based Bioinformatics and Biosignal Analysis Virtual Laboratories for Neuroscience Education in Universities

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Rapid growth of information technology in India propelled implementation of digital and elearning resources in science and engineering education. Government has been taking initiatives for developing diverse e-learning resources, such as virtual laboratories to provide experimental skills for science experiments and for analysing scientific data, there have been plans for developing more web-enabled experimentations for enhancing digital education and immersive learning experiences (Ray, Koshy, Reddy, & Srivastava, 2012). Studies indicated the role of existing virtual labs as a teaching tool with their classroom lectures as they reduce their workload to a significant extent, as an examination component for students to access their learning curve and as an adaptive learning environment for improving the performance level of user community (Diwakar et al., 2016). Effectiveness of online education platform depends on the quality of preparedness of the content and design of experiment protocol for addressing the learner's needs for education (Afgan, Sloggett, Goonasekera, Makunin, & Benson, 2015). With a focus of delivering realistic virtual environment for learners to get a hand-on experience on performing biosignal processing and data science, we developed and deployed two new virtual laboratories; Biosignal Processing and Analysis lab and Bioinformatics and Data Science in Biotechnology. The Biosignal Processing and Analysis lab focuses to equip students from engineering and biosciences with the fundamental neuroimaging tools that are used to describe, analyse and process common biological signals. The main focus of EEG stimulator lab is on processing EEG signals and events that is aimed to help students to analyse and classify event-driven variations with specific tasks such as motor tasks, visual perception, working memory and cognitive aspects of yoga and meditation for understanding neural correlates underlying specific cognitive activities (Kumar et al., 2021; Radhamani et al., 2021). The course will also help students without backgrounds in neuroscience, biology or other fields to understand and explore signal-related aspects in real-world data. Bioinformatics and Data Science in Biotechnology virtual lab focuses on introduction to the basic practical techniques in bioinformatics and bioscience data processing using basic yet research-applicable educational methods. Through data manipulation, the lab introduces R to many bioscience students. The lab is designed to provide practical training in bioinformatics methods including retrieving public sequence databases, use of different computational tools to find sequences, analysis of protein and amino acid sequences without the need of many other software packages. The designed laboratories provide a step-by-step practical introduction to computational sciences in biology and biotechnology with user interactive simulator platform. It can readily run code processing real biology data with a background programming platform allowing a novel multi-device installation-free access to data science methods for biotechnology and bioinformatics and for processing real EEG and biological data with free access to relevant signal processing methods in application-oriented scenarios. The web outlook of laboratories matches with mathematical simulators with easy-to-use simple GUI and with extended educational and research capabilities. Successful development and implementation of such labs will diversify interdisciplinary curricula in the neurosciences and data sciences to understand functional neural underpinnings of human behaviour (Ledwidge, Foust, & Ramsey, 2018). The interest in learning neuroimaging techniques with real time EEG biosignal processing and data analysis have been on the rise in recent years, and these platforms were publically available and the clinicians from anywhere can easily access and use EEG analysis and bioinformatics studies workflows in laboratory which are in mainstream of life science education (Alphonse & Diwakar, 2020). Deploying academic and biomedical research based virtual laboratories with new immersive and interactive technologies has

potential to address Bioinformatics-related exploration and bio signal analysis and its relation with artificial intelligence in the future.

Keywords:
Virtual laboratories, bioinformatics, EEG analysis, online education.

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Effect Prospective Memory Loading on Accuracy of Prospective Memory and Ongoing Task

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Introduction:
Prospective memory (PM) is the ability to implement a planned intention, thought or an action in the future (Gonen-Yaacovi & Burgess, 2012). PM task has two components, an ongoing task and an embedded PM task. A study on one vs three PM targets reported better performance for one PM target condition compared to 3 PM target condition (Einstein et al., 1992). Increase in prospective load leads to poorer performance (Kidder et al., 1997). Improved PM accuracy comes with a cost on ongoing task performance according to the Preparatory Attentional and Memory (PAM) processes theory (Smith & Bayen, 2006). PAM states, either one of the tasks suffers due to division in resource allocation. However, some studies did not have cost effect on PM task (Einstein et al., 2005). Performance Index (PI) is another good estimate of overall PM performance along with ongoing performance (Guerdoux-Ninot et al., 2020). Higher PI is a good indicator of PM task performance.

Need:
Literature suggests mixed results about imbalance caused in PM and ongoing accuracy with increasing PM complexity. The imbalance seems to vary across tasks depending on the stimuli. For aging studies, to evaluate the effect on tasks with increasing PM complexity, it is important to assess how young-aged adults (YA) would perform on ongoing and PM accuracies with increasing PM complexity.

Aim:
Assessing the effect of PM complexity on ongoing and PM accuracy, cost of ongoing accuracy and PI.

Method:
Cross-sectional PM assessments were done for 26 college-going healthy YA (25.7±6.1yrs) (Sacco, 2013) with a score ≥26 on MMSE. Those with history of psychological/psychiatric/neurological deficits were excluded from the study. Prospective memory task was adapted from tasks used by Bajaj & Bhat, (2017) where PM tasks were embedded in letter judgement task (LJ) and number judgement task (NJ). For assessing effects of increasing PM complexity, four versions of LJ and NJ tasks were designed. First version of both tasks comprised of only ongoing tokens wherein no PM targets were embedded. As a part of ongoing-only condition, 276 token of each of the two tasks were presented wherein participants identified the letters that appeared first in the alphabetic order out of the two letters in LJ task and the greater digit out of the two numbers presented in NJ task by pressing the corresponding arrow key. In the remaining three conditions 24 PM tokens were added to the 276 ongoing tokens (Notebaert et al., 2019). The PM tokens were randomly embedded in LJ and NJ task with minimum interval of 6 and maximum interval of 17 between each PM token (Notebaert et al., 2019). The second condition (PM complexity 1) required the participants to press 'Spacebar' key when both the letters presented were vowels in LJ task and when both the numbers presented were even numbers in NJ task. In third condition (PM complexity 2), in addition to the second condition, participants were asked to press 'Z key' when any one of the letters presented was a vowel in LJ task and if both the numbers were odd numbers in NJ task. During fourth condition (PM complexity 3), in addition to second and third conditions, participants were asked to press 'M key' when the letter combination was 'V and N' in LJ task and when the number combination was '4 and 7' in the NJ task.
All four versions of both LJ and NJ tasks were embedded in Licenced Paradigm software v2.5.0.68. The tasks were presented in random order with increasing complexity. Ongoing task accuracy, PM task accuracy, PI (Guerdoux-Ninot et al., 2020) and ongoing cost (Meier & Zimmermann, 2015) across four versions of LJ and NJ tasks were analysed.

Results and discussion:

With increasing PM complexities, there was reduction in PM accuracy score on PM complexity 1 (LJ:17.9±7.16; NJ:13.8±6.34), PM complexity 2 (NJ:9.85±5.87), and PM complexity 3 (LJ:16±6.05; NJ:8.96±4.75) except for LJPM complexity 2 (18.8±4.75). These differences were statistically different for NJPM accuracies [F (2,25) =13.9, p=<0.001)] wherein the differences in PM complexity 1 as compared to PM complexity 2 and 3 were significant. This can be attributed to the increase in PM load as the complexity increased (Einstein et al., 2005). LJPM accuracy was better than NJPM, which emphasizes its sensitivity towards detecting accuracies in both ongoing and PM condition without significantly disrupting either of their performance. Cost of PM accuracy on the ongoing task accuracy was computed. Although the participants performed poor in NJPM task, performance on ongoing task accuracy was better in NJ task [Complexity 1:MD=4.88, Complexity 2:MD=3.8, Complexity 3:MD=3.8; F (3,25) =1.92, p=0.13]. However, good LJPM accuracies resulted in cost of ongoing LJ task accuracies [Complexity 1:MD=7.88, Complexity 2:MD=8.5, Complexity 3:MD=18.8; F (3,25) = 5.48, p=0.002] implying that cost of PM accuracy on ongoing task was higher for LJ task compared to NJ task. This inverse trend is in favour of the PAM theory stating, the processing resources required to perform a task is compromised with addition of PM load. In this situation, either PM performance suffers or the ongoing performance suffers depending on resource allocation while performing the task (Meier & Zimmermann, 2015). The present finding concludes that NJ task would be a better predictor of determining the disruption in balance between ongoing and PM accuracies due to increase in PM load. PI significantly deteriorated with increasing complexity for NJPM task [F (2,25) =13.3, p=<0.001]. Similar trend was not seen for LJPM [F (2,25) =1.68, p=0.2]. Results of PI indicates the sensitivity of NJ task with increasing task complexity.

Conclusion:

This study aimed to determine trends in PM performance across increasing complexities on YA. PM accuracies were assessed by embedding them in LJ and NJ task. PM accuracies decreased with increasing complexities. LJPM accuracy were found to be better than NJPM accuracy. However, LJPM reflected cost on ongoing accuracy with increasing PM load. PI was better for LJ task compared to NJ. Henceforward, we propose that LJ task is a sensitive task to detect PM load-related effect on ongoing and PM accuracy. However, NJ task is a better predictor to determine cost of PM load on ongoing performance

Learner Perception and Preferences of Using Virtual Laboratories in STEM education pre- and post-COVID -19 Pandemic

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The crisis of the COVID-19 pandemic forced the education institutes to adapt and implement technology-based e-learning platforms towards a strategic plan to bring evolution and change within higher education system (Greitzer, 2002). Providing free access to information and scientific learning is crucial in a country such as India where students typically have access to limited resources. While theoretical concepts could be covered efficiently through online mode, conducting laboratory courses at university level still posed challenges in the context of sustainable development goals, the potential factor to meet quality education. According to cognitive framework for learning, the use of innovative multimedia technologies with interaction element were preferred for improving learner perception and to make learning effective and productive (Mohamed, Id, Hamed, & Bolbol, 2021). Virtual laboratories are Massive Open Online Courses (MOOCs), providing content rich learning platform including theoretical aspects, experiment set-up, equipment training, interactive animations, simulations and assessment questions as examination component to reproduce conventional laboratory experiences with relevant pedagogical features. Studies on laboratory skill education among university students showed behavioural adoption and learning intention of online laboratories as interactive textbooks for complementing traditional classroom scenarios. This study focuses on analysing user behaviour and acquisition on using virtual labs platform, pre-covid-19 days with blended learning approach and post Covid-19 times with remote learning approach. Using TAM and OER based behavioural analysis on university students (N=1059), the study showed transformation of conventional education with minimum instructor dependency using blended approach before COVID-19 days. Usage analysis indicated implementation of virtual labs as an interactive textbook for understanding theoretical and experimental concepts and user centric approach in conceptual learning with minimum instructor support. Studies also indicated user adoption in promoting laboratory skill practices and problem-solving skills in experimental learning. Comparison on usage time-user access time bins indicated user intention as assimilators, they can complete exercises without the instructor support and need an audio or video presentation for abstract conceptualization and reflective observation. Usage analytics during the COVID-19 pandemic time indicated rapid increase in the number of registered online users during the lockdown phase. Adoption of virtual labs in learning and teaching scenarios were studied using factors such as number of users, number of sessions, page views, unique views, and bounce rate (Raman & Vinuesa, 2021). Studies indicated a logistic ‘S’ shape curve for virtual laboratories adoption among students-teacher community with an early slow phase, a rapid middle phase with widespread, and a slow third phase with an incomplete penetration in the end (Radhamani et al., 2021). Studies presented the role of virtual laboratory technologies as a cutting-edge solution for ensuring equity in distant education through internet and technology-based education at lockdown phase all over the world. Assessment is the potential intrinsic factor for measuring knowledge level, practical skills and learning abilities of a student, future works will explore data from formative assessment, continuous evaluations and summative assessment for evaluating behaviour analysis of student’s pre COVID-19 and post COVID-19 timelines. This study was posed from both classroom and online perspective, it is necessary to quantify learning ratio among larger populations different subsets of learners from STEM discipline for getting a generalized understanding of how virtual laboratory components enhance skill training and problem-solving skills with minimum instructor support during COVID-19 imposed shutdown. Online laboratory education has added a uniformity for learning across the globe and brought pedagogical modalities within online platforms with reliable learning outcomes (Joshi & Vinay, 2021).

Keywords:
virtual laboratories, knowledge perception, COVID-19, laboratory skills, online education

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'Am I what I believe?' An attempt to explore Metacognitive Accuracy using Absolute Self-Estimations.

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Introduction:
Metacognitive accuracy (MA) is how well subjective-judgments about performance match performance-accuracy (Berry et al.,2020). A person is said to have good-MA if their subjective-appraisals match their objective-performance. Good-MA is crucial for a cognitively-healthy-lifestyle. An individual would choose to follow a cognitive-healthy lifestyle or choose to seek help only if one is aware of their cognitive-communicative-abilities. Poor-MA can be demonstrated either as underestimation/overestimation wherein underestimation would lead to inaccurate-implementation of optimal-cognitive-strategies, reduced motivation to enhance their cognitive-reserves whereas overestimation can lead to cognitive-failures and refusal to seek help to improve their cognitive-communicative-abilities.
A person's-MA might be evaluated on an intrapersonal/interpersonal-level. Intrapersonal-MA is measured using absolute-estimations of what one believes about one's cognitive-communicative-abilities, whereas interpersonal-MA is measured using comparative estimations of what one believes about their cognitive-communicative-abilities in comparison to peers (Ehrlinger et al., 2008). MA has been investigated extensively in the literature using either online-awareness-measures, which assess MA before/during/after performing a cognitive-task, or offline-awareness-measures, which assess MA using questionnaires/self-report-measures (Arora et al.,2021).

Proper estimation of MA at an intrapersonal-level can enable young-adults (YA) to utilize their self-knowledge and self-monitoring abilities to influence cognition and behaviour in social/non-social contexts and also help professionals design cognitive-enrichment programs. There is limited understanding in the combined-usage of online-offline-measures in determining MA in memory-EF-domains. Determining the MA is essential across every cross-section of life, the present study was designed as a preliminary-attempt to assess MA among YA.

The present study aimed at utilizing absolute-self-estimation through a combination of online-offline-measures to explore metacognitive-accuracy in young-adults. The objective of the study was to derive various-MA-profiles based on a estimation-discrepancy-measure on a variety of cognitive-communicative-tasks, explore the relationship between MA and metacognitive-beliefs, self-perceived-necessity for metacognitive-training among YA at an intrapersonal-level.

Method:
Research followed a cross-section design wherein 46 young-adults (Mean age: 21.22+1.6) were included for the study. The assessment battery comprised of COGTEL (Martin & Kleigel, 2007) and cognitive-assessment-battery (Bajaj & Bhat, 2017). Online-measure, estimation-discrepancy-measure (prediction–performance alignment) was used to assess domain-specific-MA and offline-measures (forced-choice question) was used to assess domain-specific, global-metacognitive belief and self-perceived necessity to attend training. For every assessment task, predictions were obtained. For instance, prior to task performance on a letter-ordering-task participant received practice trials and was asked 'Up to what level do you think you can order letters correctly?' Participants were asked to record their confidence in their performance for each level using a visual-analog-scale of 0-100. Predictions with confidence-ratings >80% on the given tasks were considered to compute estimation discrepancy-measure. For example, on letter-ordering-task, a prediction-span of 6 would be considered, if one predicts performance up to sixth-span with 80% confidence-rating. After completion of cognitive-assessment, forced-choice question was used to investigate an individual's domain-specific-metacognitive-belief, i.e. "In comparison to your performance on the memory/EF-tasks, how do you think your predictions were?" and participants responded as 'I correctly predicted/over-

estimated/under-estimated my performance'/ 'unsure'. Participant's global-metacognitive-belief, was examined using another forced-choice question i.e. "Generally, in your everyday-life, what do you feel about your understanding of your cognitive-abilities (like memory, problem-solving, etc)?" and participants responded as "I correctly predict/underestimate/overestimate my abilities", or 'unsure'. Lastly, the self-perceived-necessity for metacognitive-training was assessed through a question "Do you feel you need guidance in understanding your cognitive-abilities accurately?" and responses were categorized as 'yes/no/unsure'. Chi-square-test was done to test the association between online and offline-measures.

Results & Discussion:

Based on estimation-discrepancy-measure, those with a discrepancy of greater than one standard-deviation (computed from the entire data) were classified as either under/over estimators. As per these criteria, 43.5% of participants overestimated, 21.7% underestimated and 32.6% correctly-estimated their performance in memory-domain. In EF-domain, 26.08% were found to be overestimating, 41.3% underestimating, 30.4% correctly estimating. 2.17% were found to be mixed profiles in memory-EF-domains.

No statistically-significant-relationship was obtained between individual's-MA and metacognitive-beliefs in memory (X 2 (12, N=46) =9.74, p=0.639)/EF-domain (X 2 (12, N=46) =16, p=0.192). In memory-EF-domains, 80% and 78.6% of correct estimators believed their predictions were high/low/unsure in comparison to their performance. Correct estimators did not reflect well-known fact in research that retrospective-estimations are more accurate than prospective-estimations (Siedlecka et al, 2016). 65% and 50% of over estimators in memory-EF-domains, felt their predictions were correct/low in comparison to their performance. This finding is in accordance with Dunning-Krugger-effect where, low performers generally tend to overestimate their performance as they do not completely gauge performance since they are only motivated to self-enhance themselves. 70% and 57.8% of under estimators in memory-EF-domains, felt their predictions were high in comparison to their performance. Skilled individuals tend to underestimate themselves (Kim et al, 2015).

No statistically-significant-relationship was obtained between individual's MA on tasks and individual's global-metacognitive-beliefs in both memory (X 2 (12, N=46) =11.5, p =0.483) and EF (X2 (12, N=46) =22.5, p=0.032). Although 21.7% and 26.08% reported their global metacognitive-beliefs aligned with their domain-specific MA, 78.3% and 73.9 % reported a misalignment in memory-EF-domains. 50% and 83.3% of over estimators, felt they correctly/underestimated and 30% and 42.1% of the under estimators, felt they overestimated their general-cognitive-capabilities in memory-EF-domains. 66.6% and 71.4% of correct estimators felt they over/underestimated their general-cognitive-capabilities.

Participants overestimating could be attributed to their general incompetence and ignorance of it. One can self-regulate only if one is aware of their inadequacies. Our research findings are in agreement with unskilled-unaware-effect i.e, poor-performers simply lack necessary metacognitive-expertise to realize their ineptitude (Kruger & Dunning, 1999). Combination of poor-self-awareness and low-cognitive-ability leads them to overestimate their own-capabilities. Good-performers have been shown to underestimate their performance (McIntosh et al., 2019), hence underestimating profiles may have been obtained. People are equally prone to overestimate/underestimate their performance on easy/difficult tasks (Burson,2006), hence a variation in MA across domains could have been obtained due to the unique qualities of chosen-tasks.

No statistically-significant-relationship was obtained between individual's-MA and self-perceived-necessity for metacognitive-training on memory (X^2 (6, N=46) =11.5, p=0.073)/EF-domain (X^2 (6, N=46) =6.52, p=0.368). 26.6% and 41.9% of participants with poor MA rightly perceived the need-for-training. However, 26.6% and 32.25% did not feel the need for-training memory-EF-domains. The large proportion of participants who are unaware of the training-requirement is alarming. They should be informed about their cognitive communicative-capabilities and a speculative-metacognitive-training-programme should be constructed rather than allowing them to stumble aimlessly.

Summary & Conclusion:

The outcomes of this study highlight that poor-metacognitive-accuracy-profiles do exist at an intrapersonal-level among young-adults. A large proportion not willing to seek remedial-measures is concern for the ageing-population and should be a target for researchers

TURNOVER DECISION MAKING UNDER RISK: Evaluating the Mediating Role of Organizational Justice and Organizational Commitment among the Security Personnel in Jammu & Kashmir

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Employee retention remains a critical issue for organizations because of the associated costs, disruptions, and potential loss of valuable knowledge, skills, and organizational memory. Considerable research describes the factors that push employees to voluntarily leave organizations (e.g., job dissatisfaction), factors that pull employees away from organizations (e.g., alternative job opportunities), and the processes by which individuals make turnover decisions. However, our ability to explain and predict individual voluntary turnover decisions remains limited. Some employees who are satisfied with their jobs leave, while many who are dissatisfied stay.

Further, another aspect of turnover decision-making that turnover models have not adequately considered is the risk associated with quitting one's job and the potential that research on risky decision-making has for advancing understanding of turnover. The research will define risk and present turnover as a risky decision; review previous applications of risk in turnover theory; review literature on decision-making under risk as it applies to turnover; integrate these literatures and provide propositions. The literature supports that individual differences, frames of reference, the decision context, and social influences affect perceptions of the risk associated with quitting as well as the willingness to take risks in this particular situation. The implications of turnover risk propensity for turnover theory and research will be discussed in explaining turnover decision making among security personnel of Jammu and Kashmir.

The work environment in Jammu and Kashmir is complex for the security personnel due to religious, cultural and political sensitivity and an issue of international concern. However, Jammu and Kashmir police have to work in and against the society to which they themselves belong. High attrition within the security personnel impacts group cohesion and effectiveness (Ramdass, 2015), and therefore affects unit performance (Shaw, Gupta, & Delery, 2005). However, there have been no such comprehensive study on turnover within the security forces and hence no understanding of the problem.

Further the study will be first of its kind to analyze the role of recently adopted monitory schemes and other non-monetary benefits for retaining the police personnel. While the literature is replete with work on the topic in the civil domain, there is a noticeable dearth of similar efforts in the military field, especially in the Indian context. Thus, the present study addresses issues related to retention in the Indian security forces, and thereby develops and empirically tests a conceptual model for the propensity to leave. Further, mediating role of organizational justice and organizational commitment shall be explored. In this research, an attempt shall be made to integrate research on risky decision-making in general (Kahneman & Tversky, 1979) and risky decision-making in an organizational context (Sitkin & Pablo, 1992) into the context of turnover decision making. Drawing on this research, it is proposed that risk influences the decision-making process of workers as they consider the decision to quit. With insights derived from Steel (2002), turnover theory relies too heavily on rational analytic decision models, and suggest that alternative decision theory frameworks are good jumping off points for advancing turnover theory.

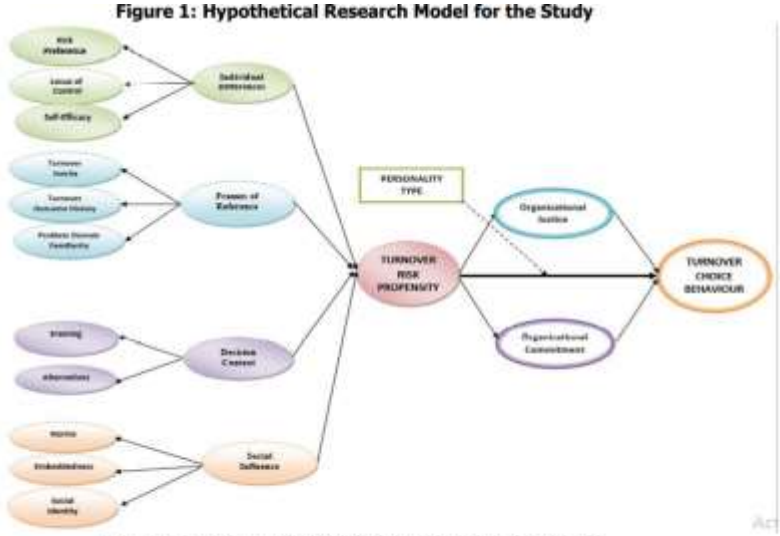
Taking into account past research and Indian contextual inputs, the factors that are expected to play a vital role in turnover decision making in the Indian Military have been grouped under four categories: Individual differences, Frames of References, Decision context and social factors. In light of the above, a proposed framework is presented, as shown in Figure 1.

This study presents a conceptual model of military turnover decision making based on the reviewed military and non-military literature and the work done by the members of the NATO Task Group on Recruitment and Retention of Military Personnel. Consistent with the unfolding model of turnover

decision-making mediational role of organizational justice and commitment are expected to influence turnover behavior.

The mediation analysis shall be used to evaluate the mediating effect of organizational justice and organizational commitment between turnover risk propensity and turnover choice behavior. The moderational analysis shall evaluate the interaction of personality differences on the relation between turnover risk propensity and turnover choice behavior.

Figure 1: Hypothetical Research Model for the Study



Source: Sitkin & Pablo, (1992); Kahneman & Tversky, (1979)

Therefore, the following questions arise:

I. What is the turnover scenario among the security personnel of Jammu and Kashmir? Why security personnel having intention to stay leave the organization and security personnel having turnover intention stay in the organization?
II. How turnover decision is made by the security personnel of Jammu and Kashmir? As turnover in J&K security personnel can lead to:
    - Expertise to the rebellious organizations.
    - Information to the rebellious organizations and countries.
    - Weapon to the rebellious organizations.
    - Increased morale to the rebellious organizations.
III. What role does antecedents of organizational justice and organizational commitment play in turnover decision making among security personnel in Jammu and Kashmir?
IV. What role does personality differences play in turnover behaviour among security personnel in Jammu and Kashmir?

In view of a of above questions, the fallowing specific objectives have been put down

I. To explore and identify the most appropriate antecedent of turnover decision making, personality type, organizational justice and organizational commitment.
II. To evaluate the mediational role of turnover risk propensity between turnover decision making and turnover choice behavior.
III. To evaluate the mediational role of organizational commitment and organizational justice between turnover risk propensity and turnover choice behavior.
IV. To evaluate the moderating role of individual personality type on the relation between turnover decision making and turnover choice behavior.

A sample frame of Jammu and Kashmir security personnel shall be used for selecting the sample. Data shall be collected through questionnaires using Likert type scale from a sample selected through stratified random sampling.

The sequential exploratory mixed methods research approach shall be used in this research. This method is characterized by two distinct phases: an initial qualitative phase followed by a second phase of quantitative data collection and analysis.

In the phase 1(qualitative phase) of Mixed Method Research study, data shall be collected through a semi-structured interviews from selected sample to develop the questionnaire. However, before collecting the final data for descriptive and inferential statistics proper instrument development and purification shall be performed in pilot study stage.

In phase 2 (quantitative phase) an **experimental design** incorporating a turnover scenario shall be utilized to examine the effects of risk on turnover decisions. This analysis will help to explain how risk shapes the decision-making of employees considering leaving their current organization.

The study shall use **vignettes** to induce participants to make a turnover decision. Even though the vignette approach is hypothetical, vignettes are a commonly used method in behavioral research (Murphy et al., 1986).

Turnover scenario shall be developed and fallowed by a **well-designed questionnaire** containing the turnover scenario and measures for all study variables.

The study is having significant contribution across disciplines including social, defense, economic, academic, and theoretical and policy aspects. This study provides a novel effort to empirically establish those factors that cause servicemen and servicewomen to leave the Indian security forces prematurely. The outcomes so obtained may help the Indian military mitigate the problem of attrition and help attain a higher level of operational preparedness.

Key Words:
Turnover Decision Making, Risk Propensity, Organizational Justice, Organizational Commitment, Security Personnel

'Are my cognitive abilities really as good as others?' - A study to explore metacognitive abilities

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Introduction:

Metacognition is one's awareness of their cognitive abilities. Metacognitive abilities wherein one rates his/her cognitive abilities relative to their peers is called as comparative self-evaluations (CSE) (Dunning, 2011). These social comparisons are essential in making better assessment of one's abilities, determine if one is 'on track' with their abilities, motivate people to improve their abilities and beneficial during social networking. Research has examined young adult's (YA) metacognitive abilities at such social comparison level for tasks like logical reasoning, grammar skills, humour, emotional intelligence and exam performance and have concluded that young adults tend to overestimate or underestimate their abilities. These self-perceptions are task-specific and varies with domains. Little is known about the distribution of CSE for everyday cognitive abilities such as memory and executive functions (EF). Thus, the present research aimed at exploring the CSE among young adults. The primary objective of the study included deriving CSE profiles based on the relationship between cognitive performance and CSE. The derived profiles were compared to extract differences, pertaining to cognitive performance, everyday cognitive QoL, cognitive strategy usage, and self-perceived necessity for metacognitive training.

Method:

The study recruited 50 healthy YA (Mean age: 21.22+1.6), pursuing graduation degrees. The CSE was assessed using a forced-choice question i.e. 'When compared to your peers, what do you feel about your memory/EF abilities' wherein participants could respond as 'my memory skills are better/at par/lower than people of my age' or 'Unsure'; cognitive performance using COGTEL (Kliegal et al., 2007) and cognitive assessment battery (Bajaj & Bhat, 2017); QoL using Everyday Cognitive Communicative QoL (ECCQoL, Anchan et al., 2016) questionnaire; and cognitive strategy usage questionnaire examined the frequency of strategy use in domains of external strategy (ES), internal strategy (IS), and metacognitive strategy (MS). The assessment of self-perceived necessity for metacognitive training was assessed using a forced-choice question i.e. "Do you think you need guidance in understanding your cognitive abilities". The participant's response was categorized as yes/no/unsure.

Based on percentile ranking, participants were categorized into high/low performers if their scores on cognitive assessment tasks belonged to the first/fourth quartile respectively and average performers if they performed within second and third quartile. The performance levels of the participants were then associated with their CSE and those with performance profiles matching with CSE were categorized as 'correct-estimators'. Participants were categorized as 'over-estimators' or 'under-estimators' if their performance profiles were lower or higher than their CSE respectively. The association of these estimated profiles was then studied with their cognitive performance score, ECCQOL score, cognitive strategy usage score, self-perceived need for metacognitive training respectively.

Results & Discussion:

Based on the estimation and designation criteria, 24.4% YA were classified as 'overestimators', 26.5% as 'under-estimators', and 43% as 'correct-estimators' in the memory domain. For EF, 24% were classified as 'over-estimators', 28% as 'under-estimators', and 48% as 'correct-estimators.' The 'under-estimating' YA (Memory:44.5+4.12; EF:51.7+5.62) obtained significantly higher performance scores on cognitive tasks followed by 'correct-estimators' (Memory:37.6+3.3.6; EF:42.5+4.84) and 'over-estimators' (Memory:32.3+4.79; EF:31.1+2.95) {Memory [F (2,43) =29.8, $p<0.001$] and EF [F(2,43)

=56.8,p<0.001]}. These results are in consensus with existing studies (Sheldon et al., 2010) and can be supported by the DunningKruger-effect (Kruger & Dunning, 1999) that suggests that low performers overestimate their abilities while high performers underestimate their abilities. The skills needed to self-evaluate one's ability are same as those needed to perform a cognitive task. Because 'under-estimators' lack this skill, they poorly performed on cognitive tasks, mis-estimated their abilities and failed to recognize when others outperformed them, resulting in an inflated estimation. However, the concern in top performers is different. They possess the skill essential to perform on the task and for judging their own performance. These individuals suffer from a false consensus effect where they believe that others must have performed as well as they did thereby fail to recognize
their superior performance at a social level. From a clinical point of view, 'under-estimators' with the potential to thrive, may hesitate to consider intellectual opportunities because they wrongly feel that they are not better than many others.

Though not statistically significant, the 'over-estimators' (memory:95.0+14.3; EF:76.5+12.7) obtained highest ECCQol score signifying best QoL followed by 'correctestimators' (Memory:89.2+12.5; EF:73.9+11.5) and 'under-estimators' (Memory:83.5+12.3; EF:68.3+11.5). With respect to cognitive strategy usage, 'over-estimators' reported highest dependence on External strategies (31.5+11.0) and lowest dependence on Internal Strategies (48.2+13.4) and Metacognitive Strategies (39.5+11.9) score when compared to 'underestimating' YA (ES:29.3+10.7; IS:56.5+17.1; MS:48.6+13.9) for memory domain. For EF, the 'over-estimating' YA (ES:26.2+7.44; IS:47.3+13.4; MS:37.5+12.2) had the lowest strategy use scores while the 'under-estimators' obtained the highest score (ES:30.2+10.7; IS:54.7+17.2; MS:45.5+12.5) across all the three strategies. However, these differences were not statistically significant. The higher QoL in over-estimators when compared to under-estimators can be associated to their highest dependence on external cognitive strategies when compared to underestimators. Studies have shown that usage of external aids as a compensatory strategy can enhance performance. However, we debate the reliability of the self-reported QoL scores for both under-estimators and over-estimators. Because of their lack of self-awareness, these self-reports may be significantly inflated or understated.

With respect to the need for metacognitive training, though not statistically significant, 40% of the 'over-estimating' and 'under-estimating' YA felt the need for training while the rest were either unsure or denied. These results indicate that 60% of the individuals with poor metacognitive abilities do not want to do anything about their misestimation which appears to be worrisome for aging individuals in a developing economy.

Summary & Conclusion:

The results suggest that more than half of the young adults have poor metacognitive abilities. These can have adverse consequences on their cognitive wellbeing and social functioning. To protect them from such consequences, metacognitive training aimed at improving cognitive abilities, self-awareness of abilities and awareness of the peer performance for under-estimators; and programmes aimed at increasing awareness of the peer performance for over-estimators should be devised. We debate on the reliability of responses on self-reported QoL questionnaire from participants with poor metacognitive abilities. Future research can consider including responses from significant others which can serve as proxy.

Cognitive achievement in offspring of diabetic mothers

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Background:
Indians develop diabetes at a younger age and at a lower BMI compared to Europeans. This contributes to high prevalence of diabetes during pregnancy in Indian mothers. Studies from high income countries show that obesity and diabetes in mothers causes fetal overnutrition (macrosomia), affects fetal neuro-development and poor cognitive outcomes in the offspring. In contrast, a large proportion of Indian mothers and young children still face undernutrition and Indian babies are the smallest in the world. It will be important to understand the influence of maternal diabetes on offspring brain development and its effects on neurocognitive achievements and human potential because they might be very different than those in the well-nourished population of the developed countries.

Aim:
To examine cognitive achievements and their neural correlates in Offspring of diabetic mothers (ODM) (children, adolescents and young adults of Type 1, Type 2 and Gestational Diabetes Mellitus (GDM) mothers) as compared to offspring of nondiabetic mothers (ONDM).

Methods:
The Diabetes Unit, KEM Hospital Research Center, Pune has a registry of more than 1000 diabetic pregnancies. ODM aged above 6 years and age gender matched ONDM are being assessed for 1) neurocognitive performance on age-appropriate tasks 2) Scholastic performance (NIMHANS SLD battery) 3) Behaviour and temperament (Strengths and difficulties questionnaire-SDQ) 4) Body size and composition, glycemic status 5) Brain activation using functional near infra-red spectroscopy (fNIRS) 6) Confounders – parental education, socio-economic status and home environment.

Modification due to COVID pandemic:
Under IEC guidance, due to the ethical imperative of assessing healthy minor children during pandemic; the study is being performed in two phases: A) Online interview for information on scholastic performance behavior and temperament B) Physical assessments for neurocognitive performance, metabolic status and fNIRS after pandemic subsides.

Results:
Online interviews were conducted on 66 ODM and 54 ONDM between August to December 2021(age range 8-27yrs, median15yrs, 71 males). Both groups were similar on confounding factors age, gender, home environment and adverse childhood experiences, except SES which was higher in ONDM group. Compared to ONDM group, ODM had higher rates of maternal complications (prececlampsia) during pregnancy (36%vs 17% p=0.02), LSCS (72%vs47% p=0.003) and neonatal complications (22%vs8% p=0.02). There was no difference in median birth weight (2.75vs2.72kgs) and rates of large for age babies. The ODM (<18yrs) had higher total difficulties score on SDQ(p=0.02) specifically in the externalising and hyperactivity domain (p=0.04). A non-significant increase in reading difficulties was observed in the ODM group.

Conclusion:
Preliminary findings from this ongoing study in an Indian cohort suggest that ODM are more likely to be borne by LSCS, experience greater perinatal and neonatal complications but have normal birth weight. They are at greater risk for adverse behavioral outcomes and scholastic difficulties. Cognitive outcomes and functional neural correlates will be examined in future assessments on the cohort.

COGNITIVE LEARNING IN TELEOST

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Teleost are the ray –finned fishes belonging to class Actinopterygii. They are most advanced of all fishes and are dominant in both marine and freshwater habitats. Cognitive behaviour in fishes is confined to fixed action pattern. The neural tube give rise to three primary morphological vesicles forebrain (prosencephalon), the midbrain (mesencephalon) and the hind brain (rhombencephalon), which continues with the spinal cord. Brain size of fishes correlates with cognitive abilities. Telencephalon is not completely involved in learning but the lateral zone of the telencephalon homologue to hippocampus, plays crucial role in in learning in goldfish. Immediate early gene (IEGs) act as marker for neuronal activity c-fos and Egr-1 both of these genes are involved in cognitive processes , particularly in memory and learning .The expression of Egr-1 in the brain is specific to the neurons and it´s activity is regulated by synaptic activity .Teleosts fishes use a variety of spatial strategies for navigation which is based upon map like spatial memory .The lateral telencephalic pallium of teleost fish , proposed as homologous to the hippocampus region is selectively involved in spatial learning and memory , while the medial pallium region that is homologue to amygdala is involved in emotional behavior in teleost . The thalamus region also contribute input to the teleost pallium, it has been suggested that fish neural architecture is involved in cognitive information processing. Fish brain can be divided into ten main structures – olfactory bulb, optic tectum, telencephalon, mesencephalon, diencephalon, pituitary, hypothalamus, cerebellum, dorsal medulla and brain stem that controls specific cognitive functions. The teleost brains include four primary regions – the lateral part of the dorsal telencephalon involved in complex spatial learning and memory, the cerebral region involved in classical conditioning, the optic tectum that controls the sensory stimuli and olfactory bulb process involved in odour response from the environment. Some of the regions of forebrain are also involved in cognitive tasks. Hippocampus and it´s homologous region are enlarged in those species which have complex environment. Spatial learning is directly connected to spatial memory. Behaviours, such as orientation, navigation, migration or homing depend on spatial cognition. In shark's different neural substrate are responsible for different spatial memory and mechanisms, the dorsomedial pallium, like the lateral pallium in teleosts plays crucial role in learning. IEGs are expressed throughout the nervous system, that is involved in cognitive learning and social behavior. In teleosts brains there are three interrelated pallial areas that mediate cognitive behaviour and emotions - dorsocentral, dorsolateral and dorsomedial regions. Acetylcholinesterase (AchE) is the main enzyme that is found in brain of teleosts, which is very powerful biomarker of pollution stress under variety of environmental factors and chemical mixture in different geographical regions. Neuropeptide galanin act as regulator of social behavior. The preoptic area plays crucial role in the reward and motivation pathway. The previous studies suggested that teleosts possess well developed brain regions that are involved in learning, memory and social behavior.

Keywords:
Cognitive behavior, Pallium, Spatial memory, Navigation, Neuropeptide.

MULTIMODAL SCREENING FOR DYSLEXIA

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Dyslexia is a learning and language disability found in many children that primarily affects their skills such as reading, spelling and writing words despite having average or above-average intelligence. Dyslexia affects 20 percent of the population worldwide putting them at risk of life-long illiteracy and social exclusion. Researchers have identified that the ideal age to detect dyslexia in children is the early learning stage from 6-13 yrs. Identification of dyslexia in young children is challenging for both parents and teachers because of the signs being non-obvious. With early diagnosis and proper educational intervention, the long-term effects of dyslexia can be suppressed. Current screening tests rely extensively on oral or written tests that require the subjects to produce an explicit verbal response even at an early learning stage (5 to 6 years). A wide range of techniques has been proposed by researchers to detect developmental dyslexia at an early stage. The techniques include reading and writing tests, handwriting, game-based techniques, eye movement tracking, Magnetic Resonance Imaging (MRI) and Electroencephalography (EEG) scans. Based on the above-mentioned criteria, the motivation of this study is to screen and analyze the children with dyslexia, based on three modes – handwriting, eye-tracking (for reading) and MRI scans.

The handwriting of dyslexia affected children differs from the normal child's handwriting. The aspects that denote dyslexic handwriting include abnormal skewness of the letters to the left or right, inverted letters and mirroring letters. In eye movement tracking, the subjects were given a passage to read and their eye position was recorded over a constant time interval. Dyslexic children exhibit rapid saccadic movements or fixations at a certain position during reading tasks which hinder their reading ability. MRI data has been selected as one of the modes for analysis because it detects potential neurobiological abnormalities in the brain activity of dyslexic subjects. MRI shows a significant difference between dyslexic and normal subjects in structural and functional aspects. The abnormalities in different brain volumetric structures of dyslexics can be identified from static anatomical MRIs. They show the reduced grey and white matter concentration, increase in the volume of the corpus callosum, and abnormal asymmetry in the cerebellum shape. The Functional MRIs show the abnormality in the activation patterns across the right brain hemispheres of dyslexics. This method when combined with screening techniques such as handwriting and eye-tracking, helps in assessing the proper level of remedial training and medical aid required to improve the condition of that candidate.

The dyslexia handwriting dataset comprises of scanned handwriting images collected from both dyslexic and normal children. The dyslexia eye movement tracking dataset comprises of eye movement recordings at constant time intervals of both dyslexic and normal children. The dyslexia fMRI dataset contains T1-weighted Functional Magnetic Resonance Brain scans of both dyslexic and Normal subjects. The participants were selected based on initial symptoms of reading difficulties and those who underwent preliminary dyslexia tests such as handwriting tests and eye movement tracking. The dataset consists of two types of scans: Anatomical and Functional brain scans of dyslexic and typical readers. The 3D volumetric anatomical brain scans are collected during the rest phase and 4D functional brain scans are collected during reading tasks. The Brain scan data is provided in NifTi (Neuroimaging Informatics Technology Initiative) format (*.nii).

The study explores various deep learning approaches like Convolutional Neural Networks and Long-Short Term Memory Neural Networks for the screening of dyslexia. For the selected modes of data, the study proposes 2D Convolutional Neural Networks (2DCNN) paired with Denoising Auto Encoders (DAE) for image segmentation to classify the Dyslexic Handwriting data. Further, Long Short-Term Memory (LSTM) Recurrent neural networks are used to analyze the eye movement data of dyslexic children while reading. Similarly, 2DCNN model paired with Stacked Denoising Auto Encoder for image segmentation is selected to classify anatomical MRI data and A Time Distributed 2D

Convolutional Neural Networks- Long Short-Term Memory model paired with Stacked Denoising Auto Encoder for image segmentation is selected for classifying the functional MRI data. The 4D volumetric functional scans are pre-processed followed by image segmentation using stacked denoising autoencoders applied to the pre-processed images. Stacked denoising autoencoder is selected for image segmentation on the neuroimaging dataset to segment and extract features of white and grey matter in the brain areas. This is followed by Classification using the time distributed CNN-LSTM model on the 4D fMRI images and 2D Convolutional Neural Networks (2DCNN) is applied on the Anatomical MRI.

The anatomical and the functional MRI classification models provided an accuracy of 81% and 95% respectively while the handwriting and eye-tracking modes of data provided 95% and 97% of accuracy respectively. The final classification as dyslexic or non-dyslexic is carried out using the multimodal fusion technique on the results of handwriting and eye movement. Multimodal fusion provides robust predictions by capturing the complementary missing information from the other modality. Similarly, a multimodal fusion approach was applied to concatenate MRI (anatomical and functional) data. The obtained results were analyzed based on efficiency in classification. The multimodal fusion of handwriting and eye-tracking models provided an accuracy of 98% while the multimodal fusion of anatomical and functional MRI provided 96% accuracy. The multimodal fusion provided a better classification of high-risk and low-risk dyslexics when compared to the individual models. The result analysis also showed that image segmentation had a significant contribution towards improving classifier performance in handwriting and neuroimaging data. Learning games exceptionally designed based on a special curriculum for dyslexic children can help in improving the linguistics and writing ability of the identified dyslexic children. This work is a part of DST-CSRI sponsored research on “Development of Smart, Assistive Aids to Screen and Assess Dyslexic children in primary school along with curriculum development for Remedial Teaching in Regional Language (Tamil)”.

Computational Drug Repurposing Approach to Identify Potential Dpp-4 Inhibitors to Develop Novel Antiparkinson Therapy

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Parkinson disease (PD) is a neurodegenerative movement disorder caused by multiple factors causing absence of dopaminergic neurons, followed by depigmentation of the synuclein protein, and the presence of LBs which disrupt mitochondrial, lysosomal, and proteasomal function, destroy biological membranes and the cytoskeleton, and trigger neuronal degeneration. There are motor and non-motor symptoms appear in PD primary motor symptoms are tremor, bradykinesia, rigidity and early nonmotor symptoms are hyposmia, fatigue, depression, constipation. Late symptoms also appear 5-10 years after onset of symptoms as Dysphagia, Anxiety, Urinary urgency, Nocturia, Dementia.

DPP-4[Dipeptidyl peptidase-4] is the key enzyme responsible for the metabolism of the endogenous incretins GLP-1 and GIP, whose elevated levels in brain, we hypothesized, would provide neurotrophic/neuroprotective actions in cellular and pre-clinical models of Parkinson's disease (PD). On evaluating several DPP-4 inhibitors, brain and plasma incretin levels were, indeed, substantially elevated and this resulted in amelioration of parkinsonism and elevations in brain dopamine levels in a well-characterized PD model. Individuals with a history of DPP-4 inhibitor use have a slightly lower prevalence Parkinson's disease, according to this national population-based case-control report. Reduce degradation of known neurotrophic neuropeptides - such as pituitary adenylate cyclase-activating polypeptide (PACAP), substance P, neuropeptide Y, and gastrin releasing peptide may be a mechanism by which DPP-4 inhibitors protect the brain. DPP-4 inhibitors can also have neuroprotective effects by enhancing the immune system and/or bioenergetics through adenosine deaminase interaction.

Drug repurposing, is a trending method for the identification of the newer pharmacological action of an established drug molecule having initial approved indication. It is a cost-effective and economical approach for development of alternative therapies for existing dreadful diseases in a quick succession. Thus, in-silico drug repurposing technique is a highly effective approach for identifying an existing drug molecule having an anti-Parkinson therapeutic activity against the human DPP-4 enzyme. In this context, in-silico drug repurposing approach is utilized in the current biochemical standpoint to develop a novel therapy targeting the human DPP-4 enzyme. In the current biochemical standpoint, the three-dimensional structure model of human DPP4complexed with ligand 3TP {(2s,3s)-3-{3-[4-(methyl sulfonyl) phenyl]-1,2,4-oxadiazol-5-yl}-1-oxo-1- pyrrolidin-1- ylbutan-2-amine} is obtained from the RCSB protein data bank. The bound ligand 3TP is separated from the complex enzyme with the help of chimera software. The separated ligand molecule is docked in the active binding site of the target protein by using AutoDock software for validating the parameters utilized in the molecular docking process. Further, the target protein is screened with a ligand library consisting of 2890 FDA approved drug molecules to identify potential DPP-4 inhibitors to develop novel anti-Parkinson therapy. The findings of the current in-silico virtual screening methods lead to identification of molecules like meclizine, dapiprazole, thioproperazine, estradiol benzoate, idarubicin, aerius etc. as potential DPP-4 inhibitors. It was observed that meclizine, dapiprazole, thioproperazine, oestradiol benzoate, idarubicin, aerius etc. were found to be potential lead molecules against human DPP-4 enzyme. Based on their safety profile, Meclizine was selected as safe and effective drug candidates for developing an anti-Parkinson therapy against human DPP-4 enzyme.

Keywords:
Drug repurposing, Parkinson disease, Dipeptidyl peptidase-4 enzyme

Neurodevelopmental genes in photoparoxysmal EEG response

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Background:
Idiopathic generalised epilepsy (IGE) accounts for 20–40% of all epilepsies. Despite efforts to unravel the genetics of idiopathic generalized epilepsies (IGEs), success in identifying its genetic markers has been limited. Specific EEG abnormalities have been observed in IGEs. It is characterized by normal background EEG activity and generalized interictal spike-and-wave discharges in the absence of any evidence of brain lesion. Photo paroxysmal response (PPR) or photosensitivity is an abnormal cortical response to photic stimulation manifesting as specific EEG changes. It has a high prevalence in IGEs. This heritable trait shows a wide range of expression from solely occipital to generalized irregular spikes and waves. Accordingly, the PPR is graded into four types. Grade I is characterised by spikes within the occipital rhythm, Grade II by parieto-occipital spikes with a biphasic slow wave, Grade III by parieto-occipital spikes with a biphasic slow wave and spread to the frontal region and Grade IV by generalised spikes and waves or polyspikes and waves.

Aim:

The purpose of this study is to understand the molecular genetics of Grade IV PPR. A generalized PPR that is consistently triggered by photic stimulation is defined as Grade IV PPR.

Methods:
Fourteen children with IGE, exhibiting Grade IV PPR, were recruited for the study. Diagnosis of PPR was made by Neurologist. About 5 ml of peripheral venous blood samples were collected from the participants in EDTA vials. Genomic DNA (gDNA) extraction was done using the standard salting out protocol. The quantity and quality of the samples were estimated using Qubit Fluorometer.
Whole exome sequencing (WES) was done using SureSelectXT Human All Exon v5+UTRs kit on Illumina HiSeq 2500 to generate 2x100 bp sequence reads at 100x sequencing depth (~9Gb). After quality control and pre-processing, the reads were mapped onto a reference genome, followed by variant calling (SNPs, indels) and annotation. The genes barbering variants in all the 14 samples were then filtered. These genes were enriched into different biological processes using the Reactome tool.

Results:
The genes that showed variations were enriched into biological processes related to the development and functioning of the nervous system. These include, CACNA1H, COL6A2, FLG, LAMA2, MYO9B, CNTN2, COL6A3, GPR98, MYH14, NFASC, COL4A4, COL6A5, KCNN2, MYO5A, PAK6, PIGN, PRICKLE2, SCN5A, TRIO, PIGQ, RELN, SCN8A, TUBA1A, PIK3AP1, SCN1A and SCN9A.

Conclusion:

Faulty neurodevelopment leads to altered cortical excitability. Abnormal cortical development is a frequent cause of epilepsy. The fundamental aspects of central nervous system structure and function provides a long list of potential mechanisms for seizures, epileptogenesis, and epilepsy. These were further supported by genetic models of epilepsy, where mutations in the molecular components of nerve cell function have been shown to cause epilepsy in mice. Hyperexcitability of neural network is a key neurophysiological mechanism in several neurological disorders including epilepsy. The treatment principle thus attempts to suppress such hyperexcitability through inhibiting excitatory activity or enhancing inhibition. Since PPR is a photic response, detailed studies into the functions of these genes would improve our knowledge on cortical excitability.

Mechanism of mood stabilizing drug's action to explore new avenue for drug target

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Lithium is a mood stabilizing medication which is commonly used to treat psychiatric disorders, specifically bipolar disorder. The purpose of the mood stabilizing drug is to prevent highs and lows i.e., mania and depression by regulating enzymes, ion channels, etc. Mania is a psychological condition in which the person shows hyperactivity and irritability whereas in depression, the person shows loss of interest and anxiety which ultimately leads to suicide. Bipolar disorder affects about 4% of the world population from which only 1% is diagnosed. It causes both cognitive (difficulty in thinking and memory storage) and functional (Vision, hearing, behavioral and movement impairment) disability. Some Lithium is being used for about 50 years; however, its therapeutic mechanism is not fully known. It is found to inhibit two signaling pathway mainly inositol and GSK-3 in Wnt pathway. The primary aim of this proposal is to study how lithium works at the molecular level in modulating brain inositol signaling involving lithium sensitive enzymes inositol monophosphate isoforms (IMPA1 & IMPA2) and inositol polyphosphate (IPPA). Normal brain cells utilize inositol and generate inositol phosphates from the degradation of signal molecules. Inositol phosphates are then hydrolyzed by the aforementioned enzymes to replenish brain membrane inositol levels that must be recycled in normal, subnormal and hyperactive states of the brain. Developing a rat model in which lithium is chronically exposed for 3-4 weeks analogous to clinical condition is essential for obtaining clinically relevant information. A reduced concentration of inositol may be important in specific brain regions in the regulation of hyperactive cells. Based on pre-clinical experiments with exposure to lithium, it is proven that lithium inhibits the activity of IMPase and IPPase, thereby decreasing brain inositol signaling. From RT-PCR analysis of treated and untreated rats, there is an increase in mRNA levels of IMPA 1, IMPA 2 and IPPA after chronic treatment. Specific objectives such as, to determine if chronic lithium treatment alters the specific activity and quantity of IMPase 1 &2 (a candidate gene product for bipolar disorder) and IPPase in specific regions of rat brain (Brain stem, Cortex, Hippocampus, Striatum, Amygdala and cerebellum) and to characterize the minimal promoter and cis-acting regulatory elements of human brain IMPA1 and IMPA2 genes, that encode IMPA1& IMPA2 isoforms, respectively. Their regulation will be analyzed by defined transcriptional factors using luciferase expression vectors in various mammalian cell lines, including neuronal and non-neuronal cell lines. Several deletion constructs of the unusually long 3'UTR of IMPA1 mRNA in luciferase expression vectors were made and these will be compared with IMPA2 mRNA expression level. Lithium/Valproate resistant patients will be analyzed by studying IMPase Single Nucleotide polymorphism (SNPs) to find out any genetic variant that affect the sensitivity to Lithium/Valproate. These studies have been designed to understand the contribution of inositol metabolism to the etiology of bipolar disorder at the molecular level. These goals will be helpful to advance our understanding of the regulation of brain signaling enzymes of the inositol signaling pathway. This could lead to the development of specific therapeutic modification/interventions for bipolar and other mood disorders.

Keywords:
Lithium, Bipolar disorder, IMPase, IPPase, Valproate, SNPs

Cognitive Neuroscience of Behavioural Addiction: Exploring the Role of Reward and Compulsivity Circuits

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Background:
Several human behaviors, when excessive and uncontrolled, like internet gaming, gambling, social media use etc. have been brought under the realm of behavioral addiction (BA). There has been rising public health concern with regards to BA, however, there is little clarity in the neurobiological underpinnings of BA.
Many BAs share clinical features and comorbidity with substance use disorders and obsessive-compulsive disorder (OCD) which are classically described as prototype disorders with dysfunctional reward and compulsivity circuits respectively. Based on this, there are two neurocognitive conceptualizations of BA: One, it is an abnormality in "reward processing". Second, it is a disorder with "compulsivity" similar to OCD. Hence, it is imperative to examine the brain regions which subserve these two cognitive domains Further, since there is sparce data on treatment effectiveness and outcome predictors of BA, it may be interesting to explore this aspect, using cognitive behavior therapy (CBT) as the treatment modality, as it has best preliminary evidence of effectiveness.

Objectives:
- To study and compare the neurocognitive performance pertaining to reward and compulsivity paradigm between internet gaming disorder (IGD), OCD and healthy controls.
- To examine the neuro hemodynamic (fMRI) and gray matter (sMRI) differences in regions corresponding to reward and compulsivity circuits between IGD, OCD and healthy controls.
- To assess the neurocognitive changes after 3 months of treatment of Internet gaming disorder with CBT.

Methods:
The project aims to assess forty participants each with a diagnosis of IGD, OCD and healthy controls. Subjects with OCD and healthy controls will be matched to IGD on age, sex and education. After assessments of socio-demographic and clinical characteristics, they will undergo detailed neuropsychological assessments to delineate any abnormalities in the neuronal circuits whose dysfunctions have been hypothesized to underly reward/compulsivity. The compulsivity circuits will be assessed by visual spatial N-Back and stop signal task and reward circuits by delay discounting. Subjects will undergo assessments domains of global cognition like IQ, attention, cognitive flexibility and error monitoring to ensure that specific assessments are valid. Structural and functional MRI will examine the gray matter and neuro hemodynamic differences in regions corresponding to reward and compulsivity circuits. Under fMRI Subjects will undergo stroop color word task (response inhibition) and monetary incentive delay task (reward anticipation) to assess both compulsivity and reward circuits. Subjects with IGD will receive CBT based on a module prepared as a part of the project. Treatment will be reassessed after 3 months for intervention effectiveness include the baseline predictors for prognosis. Appropriate statistical methods will be used for analysis. The project has been delayed owing to COVID – it is completing only its first year of in January 31, 2022. Hence after standardization, pilot testing and creating the manual, patient recruitment has been started in August 2021.

Results:
As of December 2021, 8 patients with IGD, 6 OCD patients 7 Healthy controls have been recruited and assessed. 4 of the IGD patients have initiated therapy.

Conference:
The theoretical underpinnings of the hypothesis, rationale of methods and the preliminary findings will be discussed in the confe

Efficacy of Cognitive Retraining among patients with SUDs having Cognitive Deficits: A Narrative Review

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Background:
A substantial body of research has helped researchers gain an insight about altered Cognitive functions (attention, inhibition/regulation, working memory, and decision-making) in SUDs. In numerous, treatment modalities have been curated and applied to either prevent or treat SUDs by targeting the addiction potential of substances like alcohol and opioids. However, these modalities are often associated with worse outcomes due to cognitive deficits. Very few strategies have been developed to target cognitive deficits in SUDs and help these patients in their rehabilitation. Cognitive retraining is one of such modes. It has been found to be efficacious in addressing neuronal damage due to substance use and modulate maladaptive behaviours of patients to live their lives up to the fullest. However, cognitive retraining is regarded as a proverbial elephant due to limited scientific research on its efficacy in addressing cognitive deficits in SUDSs. The aim of this narrative review was to synthesise evidence on the effectiveness of cognitive retraining in attention span, executive functioning, memory, and processing speed in individuals with SUDs.

Methods:
This review used PRISMA guidelines and included several studies based on randomised controlled trials and quasi-experimental studies using various literature repositories including PubMed, PubMed Central, Embase, MEDLINE, the Cochrane Library, and PsycINFO until 2021. Keywords used while searching for relevant studies were 'substance use disorder', 'Cognitive rehabilitation' Cognitive remediation', Cognitive retraining', Cognitive training', 'Cognitive deficits' Cognitive Impairment', 'attention span', 'executive functioning', 'memory', 'working memory capacity', and 'processing speed'. Title and abstracts were examined in order to select relevant studies in initial search. Duplicate or irrelevant reports were removed from the list. Full articles were retrieved for summarising selected reports and included methods, participants, type of intervention, results or treatment outcomes, dropouts and limitations of the study which were relevant from the point of view of SUDs only. Studies with confounding status about the design and results were contacted for further clarifications. The whole process of study selection was recorded in details and a flowchart was synthesised including major details about inclusion and exclusion criteria followed, methods, results and conclusion.

Results:
From a total of 55,422 studies based on cognitive retraining/remediation (majority of them were based on rehabilitation of Stroke, Alzheimer's, Parkinson's, Dementia, Epilepsy, HIV infection, Cancer, COPD, and Neurological Disorders patients), only 29 studies were found to be eligible for an evaluation based on cognitive rehabilitation of substance use disorders (SUDs). Out of the selected studies, 11 studies included alcohol use disorder only, 5 looked for cannabis use disorder only, and 3 studies included Opioid use disorders only. Majority of the studies reported significant improvement in cognitive functions of the patients; however, most of them were based on memory and attention. These studies were selected and analysed on the basis of their inclusion criteria. Duplicate reports were eliminated from the search results. Evaluation was based on the design of the study, substance type, participants, characteristics of the intervention given and outcomes of the trials.

Discussion:
This review indicated that various studies have been conducted to test the efficacy of cognitive retraining in substance use disorders including alcohol, cannabis and opioids use. However, heterogeneity was seen across these studies in terms of settings, characteristics of participants, modes of interventions, their delivery process, and outcomes. Furthermore, majority of the studies reported

significant improvements in the cognitive domains (especially memory and attention) suggesting that cognitive retraining can prove to be an effective tool for rehabilitating substance users and decreasing the worse outcomes associated with other modalities. Also, a limited number of relevant and powerful studies were extracted drawing attention for future prospects about replication and conduction of research in this field that may prove to be a stepping stone in declining the prevalence of cognitive impairments in substance use disorders.

Conclusion:
Selected studies revealed different neuropsychological impacts of different types of substances and significance of the cognitive retraining processes in improving an overall status of cognitive impairment. These studies also revealed that the memory was the most sought-after cognitive domain which also remained one of the most affected domains in substance use (alcohol, cannabis and opioids). Attention was secondary to memory with no fewer negative impacts due to substance use among users.

Ethical approval:
Since, this study included the critical analysis of already conducted randomised controlled trials and quasi-experimental studies; therefore, no ethical approval was required for its conduction. Some reputed peer-reviewed journals have been contacted for dissemination of the findings.

Keywords:
Substance use disorder, Cognitive deficits, Cognitive retraining, alcohol use disorder, cannabis use disorder, opioid use disorder, Narrative review

Cultural Adaptation of M-CHAT R/F Malayalam version

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Background:
Autism spectrum disorder (ASD) is a neurodevelopmental disorder identified by impairments in social interaction and communication and the presence of repetitive and restricted behaviors/interests. The reported prevalence rate in 1-10 age group in India is 15/10,000 (0.15%) (Raina et. al., 2017). Early, accurate identification is a key to early intervention for children with autism spectrum disorder (ASD), which ensures better prognosis. However, majority of the tools for screening and diagnosis of ASD has been standardized in the English-speaking population, and is not appropriate for the Indian population, owing to the differences in native languages used. The American Academy of Pediatrics (AAP) and the Center for Disease Control (CDC) has both recommended early screening of all children for ASD at 18 and 24 months (American Academy of Pediatrics, 2006; CDC, 2015) with M-CHATR, which is a Level 1 screener. Cultural adaptation of an existing screening instrument which is psychometrically sound is an effective method to create a usable screening tool, especially for countries with limited resources and/or expertise.
This work has been undertaken as part of a Research Project funded by the Department of Science & Technology, Government of India viz., "Effect of an early intervention program in the management of cognitive, behavioural and language skills of children with ASD" in the 2-5 years age group, to ascertain the prevalence of ASD in Trivandrum, the capital district of the state of Kerala with the tool as a first level screener for ASD identification by professionals, from the suspected or at-risk for cases identified from the community.

Objective:
The current study is aimed to translate Modified Checklist for Autism Revised with Follow up (M-CHAT R/F) into Malayalam and estimate its reliability and validity. The Modified Checklist for Autism in Toddlers, Revised with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009) is a 2-stage parent-report screening tool validated to assess, risk for ASD.

Method:
Multiple forward translations, compilation, back translations, pilot testing and equivalence certification was done to translate the tool. Translation has been based on the inputs from WHO guidelines and recommendations by Sousa and Rojjnasrirat (2011). For estimating reliability and validity, the translated version, was administered to parents of 33 toddlers from Kerala, registered at a tertiary referral hospital, and had a confirmed diagnosis of ASD by a multi-disciplinary team (Median age of 34 months; 73% males), after obtaining written informed consent. M-CHAT R/F Malayalam Translation was administered first followed by the Original M-CHAT R/F (English version) along with other clinical measures which included the Childhood Autism Rating Scale (CARS) to ascertain criterion validity of the translated tool. The tests were re-administered after an average of 17 days (i.e., within 2 – 3 Weeks after the first test administration). Statistical analysis was done using SPSS Version 21. Cronbach's alpha was used to ascertain internal consistency of the translated version, and the cut off for good internal consistency was set to be above 0.70 for co-efficient of alpha. Reliability was ascertained by Test-retest reliability statistic, with reliability values ranging from 0.7 to 0.9, considered to be indicative of high reliability for the tool.

Results:
The test items of M-CHAT R/F Malayalam version have adequate internal consistency as estimated by Chronbach's alpha (α), 0.811 for the first and 0.824 in the second administration ($p<0.01$). The Test – retest reliability of the tool is found to be high ($r= 0.964$; $p<0.01$). Criterion validity has been established by correlating with Childhood Autism Rating Scale (CARS) Score ($r=0.658$; $p<0.01$).

Conclusion:

The M-CHAT R/F Malayalam version is a reliable and valid tool for screening ASD in Malayalam speaking population. This is the first study to document the psychometric properties of the translated version of M-CHAT R/F in Malayalam viz., test-retest reliability, internal consistency reliability and criterion validity for the Malayalam-speaking population. The limitations of the study include, the fact that it is a retrospective study and the small sample size.

Examining the effect of SNPs of circadian clock components in stroke induced cognitive Impairment

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Background:
Circadian rhythm governed by circadian clock regulates every biological process including cognition. The key components of circadian clock include Clock, Bmal1, Per 1- 3, Cry1 and Cry2. The molecular clock mechanism in mammals is accomplished through a cell intrinsic transcriptional/translational feedback loop TTFL. CLOCK-BMAL1 heterodimer, a functional unit of molecular clock acts on promoter of BDNF – an important factor for cognition, to regulate its rhythmic expression. Studies with clock genes knock out transgenic animals have revealed the role of molecular clock in cognition. On the other hand, in patients with Alzheimer's disease and Parkinson's disease dysregulation of circadian clock is well documented. Several genetic association studies also identified risk conferring SNPs in these clock components leading to several neurological disorders, in global manner. There is an immense role of BDNF in cognition in terms of memory, learning etc. The rhythmic expression of BDNF regulated by joint action of CREB1 and key clock factors proves it as a clock-controlled gene. The reduced level of BDNF is a common observation for cognitive impairment phenotype associated with several neurological disorders. On the other hand, the recovery from cognitive impairment either by physical exercise or drug treatment is always found to be associated with upregulation of BDNF than diseased condition. In case of vascular dementia, a post stroke condition in one third of stroke survivors the role of BDNF is quite characterised. However, this field lacks to suggest (a) role of clock genes in stroke associated cognitive impairment and (b) any relation between clock genes and BDNF in vascular dementia.

Objectives:
1. Evaluation of reported SNPs of clock component genes Per2, Cry2, BMAL1 and CLOCK and clock-controlled gene BDNF in development of cognitive impairment (CI) among stroke patients.
2. Examining the presence of any relation between BDNF and clock genes during CI after stroke: A cellular approach.

Methods:
Recruitment of Study Subjects: Both Ischemic (IS) and Hemorrhagic (ICH) stroke patients diagnosed by neurologists of collaborating Centre using clinical and radiological assessment will be considered for the study. Each of these patients will be assessed in detail by history from a reliable caregiver, neurological examination, and cognitive functions assessment.

Cognitive Parameters:
We used Kolkata Cognitive Screening Battery for primary assessment [Das et al., 2016]. Attention, Memory, Language, Visuoperceptual and Executive function were tested among patients at the 2 week and at 1 year evaluation points after stroke. All the above-mentioned tools and tests were validated for Bengali language and had been used them before [Das et al., 2020]. MMSE scores were also be recorded at the same time. While, person with any history of degenerative neurological condition and psychiatric condition such as dementia, schizophrenia with confirmed case history or medical records will be excluded from this study.
Selection of SNPs: On basis of (a) previously identified association of following SNPs like rs1801260C/T, rs4580704G/C of CLOCK, rs35333999 of PER2 and rs2292912G/C of CRY2 with diabetes, cardiovascular disease, hypertension, coronary artery disease and neurological diseases in different populations (not yet tested for stroke in India) ; (b) evidence of functional role of SNPs from experimental data, eQTL (expression quantitative trait locus) findings reported in on the GTEx portal website (www.gtexportal.org) and rSNP base prediction (http://rsnp.psych.ac.cn/quickSearch), these variants were selected for the present study.

Genotyping of SNPs: We genotyped 216 stroke patients (IS = 92; ICH = 124) and 292 ethnically matched controls for seven genetic variants in circadian rhythm regulating genes (CLOCK, PER2, CRY2), BDNF, APOE by PCR-RFLP technique/Sanger sequencing method.

Gene Expression Analysis: For gene expression study, total RNA extraction from peripheral blood mononuclear cells (PBMCs) of stroke patients and/VCI cases (n = 5; Mean age: 57.4 ± 11.1 years) and healthy controls (n = 10; Men age: 51.11 ± 6.50 years) followed by cDNA synthesis were performed. With these CDNAs the quantitative real time PCR (qPCR) was performed to measure CLOCK, BDNF expression using gene specific primers and Sybr green PCR master mix while expression of GAPDH was used as internal control.

SH-SY5Y cell culture and Oxygen Glucose deprivation (OGD) induction: SH-SY5Y cell line was a kind gift from SINP, West Bengal. Cells were maintained in Dulbecco's modified Eagle's medium (DMEM) high glucose supplemented with 10% fetal bovine serum (FBS), sodium bicarbonate (3.7 g/L) and penicillin-streptomycin sulfate (100 units/ml) placed in a 37˚C, 5% CO2 incubator. SH-SY5Y cells were plated in 35 mm dish at a density of 0.2*10^6 for 24 h. DMEM high glucose medium containing 10% FBS was replaced with glucose-free serum-free (1%) DMEM medium, placed in a constant temperature 37˚C incubator, continuously filled with oxygen-free gas (90% N2, 9% CO2 and 1% O2), after 6 hrs, replaced with DMEM high-sugar medium containing 10% FBS, and placed in an incubator at 37˚C, 5% CO2 for 21 hrs.
Assessment of cell viability: Flow cytometry analysis (BD, Accuri c6 plus) was done to determine OGD/R induced cell apoptosis through Propidium Iodide (PI) assay as per manufacturer's protocol (Calbiochem, USA). Data was analysed with its in build Accuri c6 plus software. Results were analysed by an unpaired t-test.

Quantitative real-time PCR: Total RNA was separated from neuronal cells as mentioned above. Gene expression for CLOCK, BMAL1, PER1, GAPDH (control), CRY1, and BDNF was measured by real time PCR in ABI Quant studio-5 Instrument using gene specific primers and Syber green PCR master mix [Thermo Scientific Maxima SYBR Green/ROX qPCR Master Mix (2X)] as per manufacturer's protocol. The relative expression of gens was calculated by comparative method 2-ΔΔCt.

Statistical Analysis: Hardy-Weinberg equilibrium (HWE) at the polymorphic sites was tested using a chi square test with one degree of freedom. For association study the data was evaluated for p-value, odds ratio and 95% confidence interval (CI) using Javastat (http://statpages.info/ctab2x2. html).
Statistical analysis for gene expression data was performed in Graph Pad Prism 5.0 using Mann-Whitney U-test to compare cases and controls, with a significance level $p < 0.05$. Data presented as mean log2 transformed expression ± SEM. Expression quantitative trait loci (eQTL) data was accessed from Genotype –Tissue Expression (GTEX project) website (www.gtexportal.org).

Results:
Demographic characteristics of study subjects. In the present study, demographic data and the principal variables for both Ischemic (IS) and Haemorrhagic (ICH) stroke types were compared between 216 cases and 292 control individuals (age, sex, ethnicity matched). Although we did not observe any difference for both age and sex between patients and controls but traditional stroke risk factors (like hypertension, diabetes, previous history of heart disease, habit of smoking/alcohol, high blood cholesterol level, and high triglyceride level) significantly differed between two groups with p values 0.000 and Odds ratio varied from 2.93 to 35.55. A total of 56 cases were followed after 6 months of their stroke onset for cognitive parameters. Along with an overall BMSE score calculation, dissection of different domains of cognition (Attention, Language, Orientation, Memory, Executive function, visuospatial ability) in terms of raw score analysis was performed.

Association of BDNF (rs6265), CLOCK (rs1801260, rs4580704), PER2 (rs35333999), CRY2 (rs2292912) and APOE (rs429358, rs7412) SNPs with stroke.

The genotypic distribution of selected SNPs (rs6265 of BDNF, rs1801260, rs4580704 of CLOCK, rs2292912 of CRY2 and rs429358, rs7412of APOE) were within Hardy-Weinberg equilibrium and no linkage disequilibrium (LD) between rs1801260 and rs4580704 of CLOCK was identified either in patients or control groups (r2 value = 7 and 4 respectively). The 'C'-allele 'CC' genotype of rs4580704 and 'GG' genotype of rs2292912 were observed to be associated with risk for stroke while the 'GG' genotype of rs4580704 [p-value<0.05] showed protective effect against stroke. The significance of allelic association between rs4580704 and stroke did withstand multiple testing (q value = 0.021, which is the adjusted p value for 7 variants) even after doing FDR. Here, we also identified both T-G haplotype and T-C haplotype [p<0.05] to be associated with stroke in negative and positive manner respectively.
Association of BDNF (rs6265), CLOCK (rs1801260, rs4580704), PER2 (rs35333999), CRY2 (rs2292912) and APOE (rs429358, rs7412) SNPs with Post stroke Cognitive scoring status
Due to small sample size (n=56), when we performed intra group comparison of different cognitive domains (Attention, Language, Orientation, Memory, Executive function, Visuospatial ability) for different genotypes of SNPs selected in this study, statistical significance was not achieved. However, a trend of lowering of raw scores of languages, memory for GA+AA genotype of rs6265/BDNF; memory for E4 carriers of APOE; attention and memory CC+GC genotype of rs4580707/CLOCK (p=0.089) were observed.

Gene expression analysis. Relative BDNF gene expression levels between (a) stroke/VCI patients (mean log2 expression -2.60 ± 0.388; men age 51.11±6.5 years) and controls (mean log2 expression -2.73 ± 0.5; men age 57.4±11.5 years) and (b) according to rs6265 genotype (n=15) independent from disease phenotype were compared. No significant difference in BDNF gene expression was detected for either of two cases (p = 0.7972, p = 0.3884 respectively).
Cell viability after 6 hrs. Oxygen Glucose Deprivation (OGD): An excess of 35% cell death (p = 0.0011) obtained for treated SH-SYY cells after 6 hrs. Of OGD than control plates.

Alteration of clock gene expression in OGD and OGDR: After 6h OGD followed by re-oxygenation, change in expression of Bmal1, BDNF and Cry1, Per1 ($P < 0.05$) were observed while no significant changes were observed for Clock expression in 6 OGD and OGDR.

Conclusion:
Our preliminary results indicate an involvement of circadian genes in stroke, stroke onset time and post stroke Cognitive impairment.

Temporal Structure of Heart-Brain Interaction Across Adult Lifespan

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Communication between the heart and the brain is dynamic and influences each other's' functionality. Both cardiac dysfunction and changes in the brain rhythms are prominent features of aging which can highly affect the communication between heart and brain. Hence, there is a need for more integrative view on the heart-brain dynamics. In the present study, we investigate the effects of age on the temporal modulation of the frequency specific brain rhythms time locked to the R peak of the cardiac cycle to establish a better understanding on the heart-brain dynamics. We hypothesize that the features of brain oscillations like amplitude and phase which are time-locked to the R peak change across age.

To investigate the aforementioned hypothesis, we used MEG and ECG dataset from multimodal, cross-sectional adult life-span population obtained from Cambridge Centre for Aging and Neuroscience (Cam-CAN) consisting of participants aged between 18-88 years. During resting state MEG acquisition, participants were asked to close their eyes for 8min 40s and cardiac rhythms were monitored simultaneously using paired electrocardiogram (ECG) electrodes - one on the right scapula and one on the left lower rib. The MEG and ECG data were bandpass filtered and detrended. R peaks in the ECG time series were identified using Pan-Tompkins Algorithm and were further used as the time stamps for analysis on MEG time series.

One index that can be used to study the cortical response to the heartbeat is called the heart evoked potential (HEP). The HEP represents the cortical processing of the heart-beat occurring at about 200-600 ms after the R-peak of the ECG waveform. For the HEP analysis, MEG time series were epoched 200ms pre and 600 ms post to the R peaks present in the ECG time series. The MEG epoched data was then averaged across trials and channels to obtain the evoked potentials. Further, hilbert transformation was employed on the MEG time series to obtain the phases of frequency specific brain rhythms at the R peak time stamps of ECG. The pattern of the phases was then observed across the age.

The HEP analysis revealed age-related differences in the cortical amplitude (from MEG) time locked to the R peak (from ECG) showing negative correlation (R: -0.2107; p-value: 1.9048e-04) with age whereas the cortical Amplitude (from MEG) obtained in time interval 240-320ms (i.e., post R peak of ECG) showed a positive correlation with age (R: 0.1770; p-value: 0.0018). In phase synchronization analysis, significant changes were observed in the theta and alpha frequency bands. The phase values of brain oscillations time locked to the R peak of the ECG time series showed a positive trend across age in both theta (R: 0.2357; p-value: 0.0208) and alpha frequency bands (R:0.2010; p-value :0.0496). Our results provide a preliminary framework to explain how cardiac signals are processed and represented at the cortical level across age. Heartbeat-related effects on the brain might serve as a window to understand brain-heart interaction and its role in shaping our cognition.

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Multimodal and Interpretable Diagnostic-cum-Therapeutic Framework for Epileptic Seizure Prediction

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The much-needed awareness about mental health disorders and diseases is finally reaching the public on a massive scale. One such major disorder that has been capturing the attention of most neuroscience researchers and funding agencies is epilepsy. Electroencephalogram (EEG) is a commonly used technique to diagnose epileptic patients but a major bottleneck in the traditional approaches has been the overreliance on experts to analyze the EEG data and detect epileptic fits. This is a tedious and time-consuming task that also suffers from a shortage of EEG experts.

The brain activity of epileptic patients comprises four states: preictal state is the duration just before seizure when subtle signs of seizure occurrence show up; ictal state is the duration of the seizure occurrence; postictal state is the duration immediately after seizure occurs when the patient has not yet entirely returned to his normal state of mind; interictal state refers to the period between seizures other than those previously mentioned. The duration of preictal phase is highly demographic-dependent, probably linked to biochemical mechanisms that are not yet well understood and it could be very challenging to give a specific time for the onset of the same. Daoud and Bayoumi (2019) predicted epileptic fits an hour in advance with 90-98% accuracy. The earlier we can correctly predict the occurrence of an epileptic fit, the higher the survival chances of patients.

We propose a novel model that combines diagnostic as well as therapeutic goals. We aim to predict epileptic seizures so that it outperforms the existing approaches. But the more novel feature of our work shall be to explore machine learning frameworks that can rank therapeutic interventions. There are various studies involving several pharmaceutical drugs and chemical compounds whose effects are studied for improving the conditions of mental health patients. However, there are not enough microlevel quantitative metrics to measure such improvements. Gene expression data may provide a useful solution as some preliminary works seem to indicate and so we should incorporate data from a patient's genome to track the effects of different therapeutic modules, thus seeking a more personalized healthcare objective. We shall also explore the availability of genomic data for patients even before periodic epileptic seizures started as this may help us identify causally relevant biomarkers for epileptogenesis. However, genomic data is very different from EEG data and it is also known that neurodata obtained via other modalities such as functional Magnetic Resonance Imaging (fMRI), Diffusion Tensor Imaging (DTI), and Computed Tomography (CT) scans which are more relevant anatomically mostly remain unused when predicting epileptic fits. But we could compare the spikes in the EEG data with the corresponding BOLD response for both preictal as well interictal states. This will confirm whether the selected channels are in congruence with the regions of fMRI activity and locate the specific brain regions responsible for initiating the epileptic spikes. However, integrating EEG time series with 3D images reconstructed from fMRI plus gene expression data presents a difficult multimodal machine learning challenge.

Returning to our diagnostic objective, the proposed model shall differentiate between the preictal and interictal states. We also need to be able to predict the starting of the preictal phase as accurately as possible to give the patient's attendants maximum amount of time to make proper medical arrangements. Since the collected EEG data is very noisy and is a prototypical example of multivariate time series data, obtaining predictive models with high sensitivity rates is a highly challenging machine learning task. Modern EEG neurofeedback machines consist of as many as 128 electrodes placed on the scalp of the patient to detect the electrical signals. Analyzing all of them is not efficient and is rather redundant. Moreover, an excess number of channels can lead to overfitting of the data, in turn resulting in poor generalizability.

We also need to develop real-valued vector features for the EEG data corresponding to a patient. A host of interpretable techniques such as support vector machines have been used, but they do not provide satisfactory performance. There are many models that use deep neural networks to obtain very promising results.

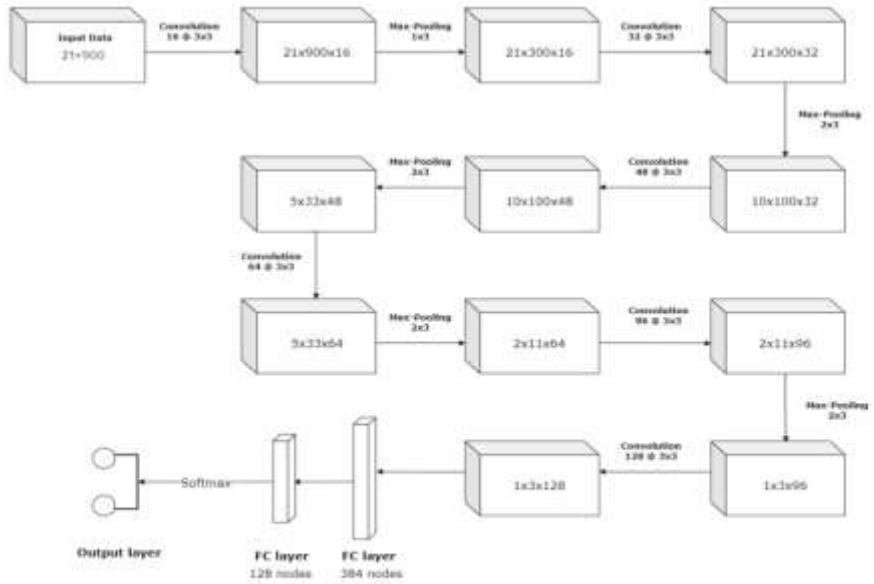

Figure shows a typical DNN architecture for multivariate EEG timeseries that comprises 18 layers, having 1 input layer, 7 Convolution layers, 7 Max Pooling layers, 2 Fully connected layers, and 1 output layer. The input layer has the dimension 21*900 (21 electrode channels and 900 values for each electrode). All the convolution layers have ReLU activation and a softmax classifier is used at the output layer.

Daoud and Bayoumi (2019) used a complex architecture combining deep convolutional neural networks (DCNNs) along with Multi-Layer Perceptron (MLP) and BI-LSTM (Bi-directional long short-term memory) to predict seizures up to one hour before onset. They used a 4 layered deep convolutional neural network as front-end to help in spatial feature extraction from the different electrode positions on the scalp. The number of trainable parameters is drastically decreased when employing DCNN because the convolutional filters ensure that if we find a feature in a particular part of the data useful then it is useful for other parts of the data as well. We shall also require a channel reduction algorithm that reduces the number of channels. This smaller set of channels is fed into the DCNN for seizure prediction. A relatively unexplored direction is that artificial neural networks may not be as good at predicting epileptic fits as spiking neural networks (SNNs). Single spiking neurons have been shown to identify all instances of different complex recurring patterns. Their application to EEG data is in a very nascent stage so we shall explore their feasibility in the context of our machine learning objective of predicting seizures as soon as the preictal phase begins.

But the medical community cannot be coerced into relying on black-box machine learning techniques when dealing with such sensitive issues as handling epileptic patients. So, deep learning needs to be augmented to meet the interpretability criterion of medical practitioners. We shall apply SHAP (SHapley Additive exPlanations) framework to preictal and interictal segments of EEG on different channels to find the decisive features that contributed most to predicting seizures and get those explanations verified by neurologists and radiologists. Originally developed for image data, researchers have modified SHAP to develop DeepSHAP and KernelSHAP for timeseries data. We shall use SHAP values to render a topographic plot that gives insights about the regions of scalp important for seizure predictions

Music Emotion Recognition via Deep Learning and comparison with human perception

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Introduction:
There has been a staggering increase in online music consumption in India, especially in the past two years [6]. Music emotion recognition (MER) is an important task in music information retrieval. The task typically involves the usage of acoustic features from music, social tags, metadata or lyrics for classifying and identifying emotions from a song. Lyrics have been neglected in MER even though they play a crucial role in eliciting emotions and also contribute to musical reward. MER task in lyrics usually involves identifying emotional connotations of lyrics using Natural Language Processing (NLP) techniques. Lately, NLP techniques for MER on English songs have evolved from using traditional techniques like word-level features based on emotion lexicon [7] to using a transformer-based approach because of self-attention and eschewing recurrence and sequential nature as recent as this year [5]. There are very few studies on MER [2, 3] for Indian Languages when compared to the English language, but none of them has used transformer models for MER on Indian languages. XLM-RoBERTa [1] is a multilingual transformer model pre-trained on 100 different languages, including Hindi. The XLM-RoBERTa model is also very competitive with strong monolingual models on downstream NLP tasks. The aim of this study is to evaluate the efficiency of the XLM-RoBERTa multilingual transformer model on the MER task for the Indian language Hindi. Furthermore, we also examine the misclassified lyrics by means of perceptual validation to evaluate the results and the model.

Methodology
We use the BolLy [3] dataset, which comprises 1055 Bollywood songs. Each song has a corresponding label of positive or negative emotion based on its lyrics. Each song is annotated for emotion by only 3 annotators solely based on lyrics, and the song is assigned the majority label. Though the annotators were not made to listen to song audio or given the metadata, familiarity with the song would lead to bias in annotations as the acoustic features may confound the conveyed emotion. The dataset has a class imbalance, as around 68% of the songs belong to positive emotion, and the remaining 32% of the songs belong to negative emotion. We fine-tune the dataset on the pre-trained model XLM-RoBERTa for text classification tasks. Given the lyrics in Hindi, the model outputs whether the lyrics have positive or negative emotions. We use the same 90:10 split of train and test as used by the original author to compare with their accuracies. We also analyze the misclassified lyrics using perceptual validation by two new annotators. The new annotators were asked to rate the song lyrics as positive or negative based on the emotion perceived without considering song audio familiarity.

Results:
We achieve better performance by the XLM-RoBERTa model on the BolLy dataset than the SVM model. Specifically, the best accuracy achieved for a 90:10 split was 82.07% compared to the original paper's best accuracy of 74.59% [3]. The perceptual validation of misclassified lyrics revealed that the annotators agreed with predictions of 50% of misclassified song lyrics, that is, the perceived emotion for 50% of song lyrics are the same as the output given by the XLM-RoBERTa model. Also, a few of the remaining 50% of the misclassified song lyrics had both positive and negative aspects thereby rendering them ambiguous.

Conclusion:
In this study, we have demonstrated the efficacy of using multilingual transformer models on MER tasks in Indian languages. The features learnt from lyrics can help improve current MER systems, which have real-life applications like automatic playlist generation, music recommendations, music therapy and similar others with songs from different languages. Multilingual transformer models have been trained in many Indian languages like Telugu, Tamil, Kannada, Gujarati and others. This helps in not

having individual MER models for each language, instead, having one model for many Indian languages.

One limitation of the dataset and our perceptual validation task was the limited number of annotators. Owing to the subjectivity of rating emotions, increasing the number of annotators can improve the reliability of the labels and remove any bias due to an individual annotator's familiarity with the song.

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One Carbon Metabolism in Health and Disease: Special Emphasis on Cognition

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One carbon metabolism (OCM) is a complex biochemical network consisting of folate cycle, methionine remethylation cycle, and transsulfuration pathway. It is a universal metabolic process that transfers 1C units (in forms of methenyl, formyl, and methyl groups) to support a number of cellular processes including biosynthesis of purines, thymidine, phospholipids and creatine; biological methylation of DNA, RNA and proteins; and polyamine synthesis for redox defense. Owing to the variety of processes that OCM supports, various impairments in its functioning and resulting metabolic imbalances are being actively investigated for their potential etiological links with a number of diseases including CVDs and neurological diseases.

Impairment in functioning of OCM is usually attributed to either genetic factors, like mutations in gene encoding for enzymes involved in OCM; or dietary factors, like folate, B12, B6 or B2 deficiency. Further, metabolic imbalances resulting due to impaired OCM, like elevated blood homocysteine (hcy) levels and reduced S-adenosylmethionine (SAM) and S-adenosylhomocysteine (SAH) ratio, have extensively been studied in connection with aforementioned diseases. While elevated homocysteine indicates increased inflammation and is regarded as a risk factor for CVDs, and several neurological disorders like Alzheimer's disease and vascular dementia; reduced SAM: SAH ratio is thought to contribute to these diseases epigenetically.

All of these factors leading to and resulting from impaired OCM, have been linked with one or the other cardiovascular or neurological diseases in various permutations and combinations. While a few of these associations have been replicated with some degree of consistency, most of them fail to remain consistent across populations. For instance, association of hyperhomocysteinemia with CVDs has been reported more consistently than association of MTHFR gene polymorphism with CVDs (which varied from population to population). These inconsistencies in associations may be a result of varied study designs, sampling techniques, or other biases that can affect the studies. However, these studies have been repeated so many times that the possibility of these inconsistencies being a result of variations in study design, sampling techniques or other biases can safely be ruled out. This implies that these inconsistencies may actually be the truth; which further implies that the framework in which we are trying to analyze 2 these associations i.e., one genetic architecture-one phenotype or one risk factor-one disease, should be re-evaluated.

This gives us an opportunity to look at these results through the lens of gene-environment interaction. Existing literature as well as a series of studies untaken by the author that explore the role of OCM in CVDs and neurological diseases strongly hints towards population specific associations of various risk factors with these diseases. It is, therefore, the interaction between the gene and the environment which is determining the final phenotype. However, a deeper analysis of these inconsistent and often contradicting associations may throw some light on evolutionary mechanisms. With the help of studies undertaken by the author, ongoing argument will further be explicated.

In a series of studies aimed at understanding the role of MTRR A > G polymorphism in cardiovascular diseases and cognitive impairment (CI) by the author, mutant MTRR allele showed no significant association with CVD risk factors viz. hypertension, obesity, dyslipidemia, hyperglycemia and metabolic syndrome; but was significantly associated with reduced risk of CI in a single mendelian population from north India. This result was in contradiction to what has widely been reported by the researchers studying in western populations. Those studies have reported the mutant allele of the MTRR gene to be the risk allele for CI. However, a limited number of studies from India supported the findings by the author.

This contradictory association may appear to be an anomaly at the surface, but further scrutiny reveals the inherent harmony between contradictory findings. Studies exploring the association of mutant MTRR allele with other conditions in varied environments may help us explain observed contradictions. In a pertinent study published by European Journal of Clinical Nutrition, the ancestral allele of MTRR gene (A allele) was found to be associated with normal homocysteine level and mutant allele (G allele) with elevated homocysteine level (a risk factor for pregnancy complications and CVDs) in vitamin B12-replete pregnant women; however, the mutant MTRR allele was associated with lower level of homocysteine in B12 deficient pregnant women. Meaning, the mutant allele was working as a risk allele in normal physiological conditions; however, it was protective in nature in B12 deficient conditions. A comparative analysis of distribution of MTRR gene polymorphisms between western and Indian populations further substantiates this hypothesis. While ancestral allele remains dominant in western populations, which are predominantly non-vegetarian and hence B12 replete, mutant MTRR allele frequency reaches up to 70-80% in various Indian populations, which are usually B12 deficient due complete or partial vegetarianism.

This hypothesis suggests that mutant MTRR allele may actually be a genetic adaptation to vitamin B12 deficiency. Interestingly, if we expand the purview of gene-environment interaction to cover both ‘contemporary’ as well as ‘ancestral environment’, replacement of ancestral 3 MTRR allele by mutant allele and inverse association between mutant MTRR allele and CI in vitamin B12 deficient populations can be explained by the same theoretical framework.

Finally, if we try to examine therapeutic interventions through the lens of expanded gene environment interaction, we would be able to understand why one intervention that works for one population sometimes proves to be ineffective or even counterproductive for others. Accordingly, if protective nature of mutant MTRR allele in B12 deficient conditions is validated in future studies, we would have to rethink on vitamin B12 supplementation as therapeutic intervention for CI, because normal physiological levels of B12 would not only mask the protection conferred by mutant MTRR allele in Indian populations, it may even put the carriers of mutant allele at a greater risk.

Keywords:
One carbon metabolism; Cognitive impairment; CVDs; MTRR gene polymorphism; Vitamin B12 deficiency

Use of Music and social media for Social Surrogacy during Covid-19 lockdowns in India

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Introduction:
The social surrogacy hypothesis suggests that in the absence of direct social contact, people tend to rely on substitutes to meet social needs. Research shows that the motives to use these social surrogates can be categorized into seven facets i.e., Comforting Company, Reminiscence, Shared Experience, Understanding Others, Isolation, Culture, and Group Identity (1). Activities like watching television, reading fiction and listening to music have been known to be used as social surrogates, but research indicates that they are used to fulfil different facets of social surrogacy. (1)
During Covid-19 related lockdowns, people were forced into isolation, and both music and social media became a very significant medium for fulfilling social needs and coping with social isolation. Research shows that there was a surge in the use of both the mediums during the pandemic. (2)(3)

While social media platforms have been utilized by people for various purposes such as expression of mental health related issues and to find a community for emotional support among others (4)(5), research also shows that maladaptive use of social media are correlated with reduced life satisfaction, depression, anxiety, and addictive behavior. (6)

In the current study, we aim to investigate which facets of social surrogacy are fulfilled by social media and music the most, and compare the use of these mediums for fulfilling social needs. Additionally, we also examine how this usage of social media is correlated with social media addiction, during the second wave of the Covid-19 pandemic in India.

Methodology:
A total of 121 participants were recruited via social media to participate in an online survey (mean age = 25.5 yrs, std = 7; 66 male). To assess the facets of social surrogacy for social media, a condensed version of the 30-item Social Surrogacy Scale (1) was used. The 30 items were condensed into 7 items based on the 7 facets of social use of Social Surrogacy (1). The 7 facets of Social Surrogacy and the 7 corresponding items are listed in Table 1. The same scale used to assess the use of Music for Social Surrogacy by replacing the term social media with Music for each of the 7 items.
Furthermore, the participants were also required to fill in Bergen social media.

Facet of Social Surrogacy	Description
Comforting Company	Social Media keeps me company, it can comfort me and make me feel less lonely
Reminiscence	I use Social Media to remind myself of a particular person or of certain periods of my life or past experiences.
Shared Experience	I can identify with the people/pages I follow, immerse myself in their posts and relate to the people or the experiences they describe
Isolation	I like to use social media because it allows me to isolate myself from the surroundings, its sounds and people
Understanding others	Social Media helps me understand the world and people around me better and makes me feel connected
Culture	The pages and people I follow mirrors the culture of my country and makes me feel connected to it
Group Identity	Social Media helps me identify with a particular social group, especially with those who like the same things and identify with a particular subculture

Table 1. The 7 facets of Social Surrogacy and the 7 corresponding items

Addiction Scale (7), a six-item scale, covering the six features of addiction that is, salience, mood modification, tolerance, withdrawal, conflict, and relapse. (8)

In order to find out the most important facets for social surrogacy fulfilled by Music and Social Media the mean rating for each factor for each of the mediums was computed. To find out whether the difference in the median scores for Music and Social Media is statistically significant, a Wilcoxson-signed ranked test was conducted on each of the facets of social surrogacy for the two mediums.

Then, the participants were divided into two groups based on their social media addiction scores, that is, the lower addiction group with social media addiction scores ranging from 0-14, and the higher addiction group with social media addiction scores ranging from 15-30. Subsequently, a Mann-Whitney U test was conducted on the scores of each of the facets to assess addiction-based group differences.

Results:

The most important facets of social surrogacy for Music were found to be *Comforting Company, Reminiscence, Shared Experience, and Isolation* while those for Social Media were *Understanding others, Group Identity, and Shared Experience*. The Wilcoxon signed rank test revealed significant group differences for Comforting Company, Remi- niscence, Shared Experience, Isolation and Culture (all $p<0.001$).Music had a higher median value than Social Media for all these facets of social surrogacy.

The two groups with lower scores for social media addiction had 64 (mean age = 27 yrs, std = 7.9; 33 male) participants while the group with higher scores had 57 (mean age = 23.6 yrs, std = 5.1 ; 31 male) participants. The Mann-Whitney U test revealed significantly higher median scores in the higher addiction group for the facets Comforting Company ($U=899.5$, $p=0.000$), Reminiscence ($U=1105.5$, $p=0.005$), Shared Experience ($U=1018$, $p=0.0009701$), Isolation ($U=1057$, $p=0.002$), and Understanding Others ($U=1231$, $p=0.042$)

Discussion:

Even though social media mimics real world social scenarios (9), on the whole music was found to fulfil social needs more than social media during the pandemic. In like with previous research, we also find that self-driven facets of social surrogacy like Comforting Company, Reminiscence, and Isolation were fulfilled more by Music. Research shows that music is a powerful tool to evoke memories, Reminiscence being the most significant facet for using music to meet social needs (1). This becomes especially important when people are forced into isolation, and are not able to have new social experiences and form new social connections. What is especially interesting is that facets of social surrogacy that are community-driven, like Shared Experience and Culture are also fulfilled more by Music than by Social Media. One potential explanation could be that during the second wave of the pandemic, social media was bombarded with distressing information which was difficult to escape, while music would have acted as a coping mechanism in addition to fulfilling certain social needs.

The facets of social surrogacy most significant for those with higher social media addiction scores as compared to those with lower social media addiction scores are the ones that are more self-driven like Comforting Company, Reminiscence and Isolation than community-driven like Culture and Group Identity. One possible explanation is that more self-indulgent use of social media, especially in a collectivist culture like India where people prioritize group cohesion, could be indicative of underlying addictive behavior. How these changes post the pandemic may constitute the object of future studies.

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What catches the eye? Priming, bottom-up processing and visual letter search

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Priming affects visual search and previous studies have largely focused on perceptual priming from stimuli presented in previous trials. Priming effects have also been demonstrated on visual letter recognition using the masked priming technique in same-different tasks. The present study aims to examine a top-down approach to letter perception. It investigated the effect of an alternative orthographic priming task on visual search. The task used abstract letter representations in the form of writing down words starting with a target letter.

The study used a mixed factorial design. Twenty participants were assigned to one of two groups (Groups O and B). Each group undertook a priming task wherein they had to generate as many words as possible for an assigned target letter within 120 seconds. All participants then completed a modified visual search task on PEBL consisting of 120 trials. In each trial, they were presented with target stimuli 'O' or 'B', which they had to detect from an array of distractor stimuli which contained the letters GQDUC. It was hypothesized that the primed letter would have significantly faster reaction times as compared to the unprimed letter.

A paired t-test for the overall primed vs unprimed comparison revealed that there were no significant differences in the reaction time to primed letters in comparison with the unprimed letters ($t=-0.609$, $p=0.28$). However, within both groups, participants responded significantly faster to letter B in comparison to letter O ($p<0.05$). During the debriefing, participants expressed it was easier to search for the letter B in comparison to the letter O. They also said that the distractor Q made it difficult to search for O. The results suggest a greater influence of bottom-up processes in the task employed. This may reflect in the increased visual confusability with the distractors, in line with feature detection theory. The absence of previously reported letter frequency effects also supports the greater involvement of bottom-up processes.

Factors like smaller sample size and poor control over environmental variables could be limiting factors for the study. Singleton tasks may only facilitate short-term priming using bottom-up processes. A conjunctive task may have been more suited for the purpose of this experiment as it may employ episodic retrieval as a heuristic. Future research should devise studies which account for conjunction of top-down and bottom-up processes.

The roles of trait anxiety, psychological flexibility and coping strategies on the mental health impacts of COVID-19 on college students in India

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Introduction:
The lives of many students had a tremendous impact during the COVID-19 pandemic. Moreover, pandemic woes got extended due to the second wave when everyone was expecting an end to a year long-suffering in India. Schools, universities and institutes were shut down, resulting in the online culture again. Further, uncertainty over the exam dates apart from the competition itself loomed the distress and added misery for those transitioning to college. Recent studies suggest that COVID-19 increases psychological stress. More specifically, quarantine is associated with emotional stress, depression, irritation, adverse changes in sleep patterns and emotional tiredness. Despite the devastating psychosocial and cognitive impact of COVID-19 on individuals suffering from COVID-19 or not, some individuals did not get affected as much as others. In this study, we evaluate the individual coping strategies and psychological flexibility, and their association with trait anxiety to explain these individual differences in psychological health (generalized anxiety, depression, and stress) and cognitive health using cognitive tasks in the context of the COVID-19 pandemic in India. Such analysis would not only help to shed more light on the underlying nature of the effects of pandemic stressors but would also enable healthcare professionals to design particular interventions at the individual level.

Method:
Total 254 college students (75 women, 176 men, 1 trans woman, 2 did not specify; mean age=20.57, median age=20) were recruited for this study and were provided monetary incentives. The data collection lasted for 3.5 weeks, starting from 22 September 2021, while the second wave was declining. The study consisted of a general demographics survey, COVID-19 specific impact variables (such as living conditions, unhealthy behaviours, impact on academic life), and delirium questions. Patient Health Questionnaire (PHQ-9) for measuring the severity of depressive symptoms, Generalized Anxiety Disorder Questionnaire (GAD-7) to assess anxiety disorder, Perceived Stress Scale (PSS-10) for evaluating the degree to which the student perceives life as unpredictable and State-Trait Anxiety Inventory (STAI-10) for measuring potentiality as well as the actuality of anxiety. To assess the coping style and psychological flexibility, Brief COPE-28 and Multidimensional Psychological Flexibility Inventory (MPFI-24) were employed, respectively. Further, Stroop Task and Sustained Attention to Response Task (SART) were used as objective measures to assess the individual's ability to inhibit cognitive interference and attention, respectively.

Results:
Among 254 college students who participated in this study, 73.6% reported having a close one infected with the virus, among which 19.7% passed away, showing the significant prevalence of COVID-19 in India during the time of the study. Further, 26.7% of the participants reported being self-infected by the virus, among which 2.9% were put on a ventilator. Among these covid infected participants, 17.6% reported experiencing strange things that they could not explain, 16.2% felt people were talking about them behind their back, and 2.9% heard or saw things that others could not, which corroborates recent findings on delirium in COVID-19 patients. On a scale of 1-5, among the sample, the mean academic stress was found to be 4.07 (median=4) and stress due to social isolation 3.93 (median=4). Three major analyses: correlational, regression and mediation, were performed to evaluate the relation of COVID-19 impact variables and psychological health.
We observed a strong negative correlation ($p<0.01$) between the measures such as perception of mental space, proper sleep, managing academics, social isolation during the pandemic with at least three out of the four mental health variables: PHQ, GAD, PSS and STAI-S (state) suggesting that poorer the student's ability to manage his/her/their life effectively the worse is the overall anxiety levels and depressive symptoms. For further analysis, these measures were collated into a single index called COVID-19 Impact Index, as they describe the overall impact on the lives of college students during the pandemic. The COVID-19 Impact Index was significantly positively correlated ($p<0.01$) with the

measures such as PHQ [ρ=0.54], GAD [ρ=0.51] and PSS [ρ=0.48], suggesting a high level of distress and depressive symptoms among students most impacted by COVID-19.

For investigating the relationship between dependent variables (PSS, PHQ, GAD and STAI-S) with the variables such as COVID-19 Impact Index, coping strategies, psychological flexibility and STAI-T, a multilinear regression model was trained for each dependent variable individually. The individual models trained for the outcome as PSS, PHQ, GAD, and STAI-S accounted for a significant portion of the variance by predicting 62.8%, 60.3%, 58.8%, and 47.5% of the variance, respectively. Significant contributors in the variance of all the models were found to be trait anxiety (STAI-T) and COVID-19 Impact Index, which suggests that the student's predisposition to experience negative emotions such as worries, fears, and anxiety is among other factors a relatively significant predictor of the negative experience during the pandemic time. Avoidant coping strategy and psychological inflexibility were also significant predictors in most of the models, suggesting that the students who chose to avoid rather than deal with the stressors posed by the COVID-19 situation were more likely to develop depressive symptoms, stress and anxiety.

The central role of STAI-T is further confirmed with the mediational analysis of the direct effect of the COVID-19 Impact Index on psychological health variables (PSS, PHQ, GAD and STAI-S). STAI-T is found to be most significantly positively mediating the direct effect in all the models compared to other parallel mediators: psychological flexibility and coping strategies, suggesting a higher increase in overall worsening of psychological health due to COVID-19 impact when a student has a predisposition of anxiety as compared to other students.

Discussion And Conclusion:

This study showed the severe impact of COVID-19 amongst the students after the second wave ended, corroborating recent worldwide studies. Further, it helped to identify specific factors that result in individual differences while dealing with the pandemic's stressors due to its uncertain nature. Predisposition to anxiety (STAI-T), among other factors, was crucial when predicting the propensity to depression, stress and anxiety; thus, such individuals could be identified early on. Health professionals can further employ approaches that promote psychological flexibility, such as Acceptance Commitment Therapy and educate about different coping styles promoting active coping

The Effect of the Type of Music on Human Attention

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Influence of listening to music on several cognitive domains have been explored in literature and the effects have been explained using the Arousal-Mood Theory. However, studies on effect of background music on attentional control are equivocal and the role of arousal is also not completely understood. The current study aimed to find the impact of the three conditions of no music (NM), music with lyrics that the participants dislike (DL) and music without lyrics (MWL) on the attention levels of the participants and the performance of three attention networks namely alerting, orienting and executive attention. The sample consisted of 21 participants in the age range of 18-30 majorly from the states of Kerala, Karnataka and Tamil Nadu from India. Participants were made to perform the PEBL Attention Network Test (PANT), in three blocks for the three conditions– NM, DL and MWL. For the DL condition, participants were asked to name a song with lyrics that they disliked which was played during this round. For the MWL condition, a popular classical song named River Flows in You, was used. All the songs were played on earphones, while the participant performed the task. The data was analyzed using SPSS-20, and according to Shapiro-Wilk test the data was not normally distributed, hence the Friedman Test was used followed by the post hoc Wilcoxon Signed Rank Test. There was a significant main effect of condition ($p < 0.017$) on the number of errors made ($\chi2$ (2) = 8.957, p = 0.011). Post hoc analysis showed significant differences between the NM condition and the DL condition (Z=-2.843, p= 0.004) and between MWL condition and DL condition (Z=-2.799, p=0.005) with DL showing higher number of errors than the respective comparison groups. However, there was no significant difference between the NM condition and the MWL condition (Z= -0.774, p=0.439). Additionally, there was a significant main effect of condition on reaction time ($\chi2$ (2) = 6.095, p = 0.047). However, post hoc analysis showed no significant differences suggesting that the small sample size may have been a limitation. There was no significant difference in the participant's alerting, orienting and executive functioning ($\chi2$ (2) = 4.667, p= 0.097; $\chi2$ (2) = 1.143, p= 0.565; $\chi2$ (2) = 0.381, p = 0.827) across the three conditions, however alerting index showed a strong trend (0.097). Consistent with some of the previous findings, this study shows that music without lyrics enhances performance as compared to music with lyrics but not the no music condition. This study also showed the music with lyrics that people dislike (DL) reduced their attention performance. The results also suggest that negative mood influences arousal/attention since DL shows a stronger alerting index as compared to the other two conditions. Future goal would be to assess the interaction of mood valence and arousal in a larger sample to characterize the influence on attentional networks.

An Exploration of the Effects of Bimodal Stimuli on Selective Attention

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Perceptual Load Theory (PLT) posits that perceptual processing involuntarily processes information to its capacity. While performing a task, there is a top-down identification of relevant and irrelevant information, led by the voluntary control of perception. Selective attention prioritizes task-relevant stimuli for processing. High load (HL) task uses up all processing capacity, with nothing/little for processing irrelevant information/distractors. During low load (LL) task, even the distractors and irrelevant information get processed. Thus, the allocation of the processing capacity depends on the load induced by the task (Beck & Lavie, 2005; Cartwright-Finch & Lavie, 2007; Lavie et al., 2004; Lavie & Tsal, 1994). Selective attention has so far been largely studied using visual domain tasks (Forster & Lavie, 2008; Lavie, 2005; Lavie et al., 2016; Macdonald & Lavie, 2011; Treisman & Davies, 2012; Weast & Neiman, 2010). For a better understanding of selective attention, and to better represent tasks in a real-world scenario, this study looks at targets and distractors in auditory and visual domains. Response times (RT) and accuracy scores are measured. This bimodal task would help us better identify the effects of modality on selective attention.

From the previous studies in PLT, it can be assumed that modality does not play a significant role in selective attention, and that there would be no significant difference in RT and accuracy scores of the participants for tasks from any modality. It could also be assumed that there would be no significant difference in performance scores of the participants for tasks with varying distractor congruency.

Twenty participants (9 females), aged 22-55 years (Mean = 35 years), were recruited from BITS Pilani's Hyderabad Campus. All of them reported normal hearing with corrected-to-normal vision.

Audacity (version 3.0.0) was used to record and process auditory inputs. These inputs were used to build the experiment in PsychoPy Experiment Builder version 3.0. RStudio, integrated development environment (IDE) for R, was used to analyse the data. Audio-Technica over-the-ear headphones were used for the auditory inputs. NASA Task Load Index (TLX) package was used for subjective task load ratings (Gore & Kim, 2019). Three colour words, namely Red, Green, and Blue, and three non-colour words, namely Pen, Lid and Mug were recorded in a sound-treated chamber in female voice. Each word was 500ms in duration and was normalized. The experiment had two tasks (a) Visual Task (VT) - visual target stimuli with auditory distractor stimuli & b) Auditory Task (AT) – auditory target stimuli and visual distractor stimuli. Refer to Fig. 1 for a typical trial.

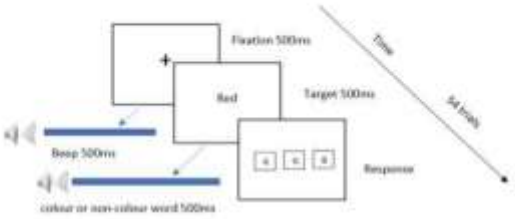
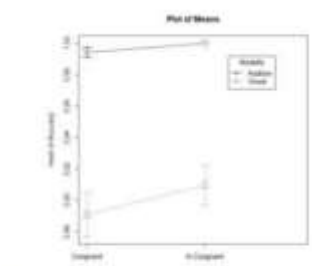
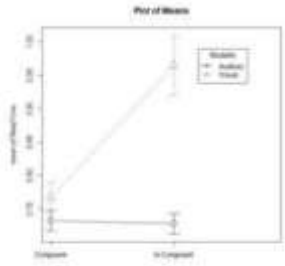


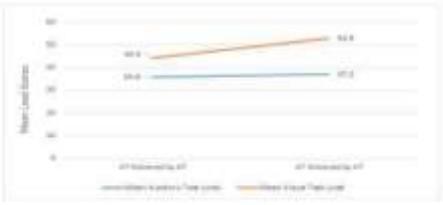
Figure 1: Schematic representation of a trial in the visual task (VT). The visual fixation '+' had a simultaneous auditory fixation beep. The target, presented on the screen, was a colour word. The distractor, presented simultaneously auditorily, was either a colour or a non-colour word. The response was recorded via on-screen buttons. The auditory task (AT) was similar, but with the auditory target of colour words, and the distractor of one either a colour or a non-colour word presented on the screen.

For measuring load of visual and auditory tasks, the NASA Load TLX questionnaire, one for each task, was given to the participants. The questionnaire has a set of six scales (Mental, Physical and Temporal Demand; Effort, Frustration and Performance). Ratings were obtained after each task was completed. The participants marked their rating on one of 20 equal intervals on the scale. A computerised version (from NASA Ames Research Centre) was used to calculate the magnitude of load using the participant ratings (Gore & Kim, 2019).

The G*Power test was conducted to find the power (1-β err prob) in an F test - ANOVA: Repeated measures within-between interaction. The effect size (f) is 0.25 and the α error probability was set at 0.05. The achieved power is (1-β err prob) = 0.73. The results on Accuracy, RT and load are shown in figures 2, 3 and 4 simultaneously.







Results:

1. The auditory distractors were more interfering while performing VT, whereas the visual distractors did not interfere much with AT. The accuracy scores were higher in AT with visual distractions as compared to VT with auditory distractors. This indicate that modality plays an important role while selectively attending to a particular target and how auditory distractors, especially incongruent distractors to the target cause more interference while performing a VT.
2. The incongruent auditory distractors were more distracting, as the RT for VT was much longer compared to AT. The RT for the congruent distractors in both modalities almost remained the same. This shows that the incongruent distractors to the target, irrespective of the modality, interfered with participants' selective attention, and had an effect on their performance.
3. Higher load scores for VT as compared to AT were observed. The participants reported higher load in VT when it was performed after AT. According to the past studies, this should have eliminated the interference of both congruent and incongruent auditory distractors on VT. But the Pearson's correlation results between VT load and RT showed a medium positive correlation and a medium negative correlation with accuracy. This implies that with the HL task (VT), the RT of the participants increased and there was a drop in accuracy rates. Even though VT was marked as HL task, it was affected by the distractors as compared to AT. According to past studies in PLT, AT should have shown higher distractor interference, but our participants reported it to be an LL task. The Pearson correlation's correlation results show no significant effect of load on RT and accuracy on AT. Contrary to the previous findings (De Fockert, 2013; Lavie, 2010), this suggests that high-load tasks improved performance by effectively blocking distractors. The present study showed a

comparatively low performance in the high-load VT as compared to the LL AT. Modality, therefore, should be considered as a significant parameter while designing tasks in PLT studies.

The present study establishes an effect of auditory and visual modality on selective attention. There is a statistically significant effect of congruency of the distractors on RT and accuracy scores of the participants. Our results also show that even though the load was high, congruency did affect the accuracy scores and RT of the participants. The results explain why people get distracted by multiple sensory stimuli while performing a task. These results emphasise on modality being as influential as load in understanding selective attention.

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Dynamic allocation of cognitive resources under risk

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The principle of the least effort, which lays out the idea that an agent tries to achieve its goal with the minimum effort possible, is well-known in many disciplines like evolutionary biology, economics, and psychology. Besides being familiar, the intuition is very obvious. Any human agent would not choose an option that accomplishes the same goals with more effort than other options. The cognitive effort also has an undeniable aversive phenomenology. The feeling of fatigue that follows an extended period of mental exertion is indicative of it. Many theories try to account for this aversive experience by describing it as a proxy of forgone leisure or of the opportunity cost of some other more worthwhile task that can be done. These theories fail to explain why we still feel mental exertion when we commit to the most worthwhile task available, and why sometimes leisure feels aversive too. A possible alternative given by Paul Schrater and S. Thomas Christie is that the aversive feeling is the indication of the current rate of energy depletion. Independent of the theory, it has been experimentally demonstrated multiple times that if given a choice, agents try to minimize cognitive effort, popularly by Kool et al. We use a variation of Juni et al. visuomotor estimation task to test the tendency of participants to minimize cognitive effort under certain conditions. In the original experiment, the task was used to study how participants sample information in a risky estimation. Hints about the location of a hidden target were given to the participant and based on that, they had to guess its position for a reward. On failure, they received zero rewards. Each hint reduced the potential reward, so the participants had to balance the cost and benefit of acquiring new information. It was observed that participants acquire more information than what is optimal, pointing towards their tendency to be risk aversive. Every new hint generated meant that they had to re-estimate the possible position of the hidden target, which required cognitive effort, and thus, these results essentially pointed out the fact that human agents expend more than optimal cognitive resources as a cost for minimizing risk. In our experiment, we test whether, under conditions of risk, people still try to conserve cognitive effort if given a choice. Two essential changes are made to the original experiment. First, to ensure that for every new hint the participant goes through with the process of estimation and expends cognitive resources, eye fixations are used. If the participants wish to draw a sample, they have to make an eye fixation inside a rectangular area 1/8th of the screen, an area that also has the hidden target inside itself. This ensured that when they are asking for hints, they have to attend to the relevant area and make the estimation. The second change is to give a choice between two such tasks. Participants were presented with two of these tasks on either side of the vertically split screen, and they could engage with any of the tasks at any time. Both the task had the same expected reward under optimal conditions, so the choice of the task with respect to the final reward over all trials did not make any difference. The only difference was that the accuracy of hints for one of the tasks was greater than the other, which meant that to be as equally confident about both the estimation of the location of the hidden target, participants would have to ask for more hints for the task that generated hints with lower accuracy. As each hint meant expending cognitive resources for estimation, one of the tasks required more cognitive effort than the other to reach its respective optimal number of hints. We saw that the Juni et al. trend was replicated whenever participants picked the 'easy task', that is they asked for more than optimal hints or displayed risk aversive tendencies, but whenever they picked the 'difficult task', they systematically asked for fewer hints. Interestingly, the average number of hints taken across all participants for the difficult task was not significantly different from the average hints across participants for the easy task. This meant that whenever they decided to guess the position of the target of the difficult task, they never asked for hints significantly greater than they would have for the easier one, on average. We believe that this demonstrates that the subjective value of effort is relatively learned and constructed as the task proceeds. Participants chose to do the easy task significantly more often than the difficult one, so globally they were risk aversive and expending cognitive resources. But locally this was not the case. Whenever they did choose to do the difficult task, their tendency to minimize cognitive effort trumped their tendency to minimize risk. This highlights the dynamic nature of cognitive effort as opposed to the static one. The static nature is described by cost-benefit models of cognitive effort where there is a single optimal trade-off account

between the cost of expending cognitive resources and the rewards accrued from the said effort. Whereas according to dynamic nature, as described by Schrater and Christie, an agent tries to optimize long-term performance. For that, it may dynamically limit how it expends resources. Although it will commit resources where the payoff is worth the cost.

Design Synthesis & Analysis Training – Impact on Innovation Abilities in Engineering Students

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When presented with open-ended questions, the human brain typically derives solutions from its long and short-term memory; however, this approach is not feasible in fields that require creativity and innovation, such as design thinking. In addition, designers tend to exhibit confirmation bias, which plays a decisive role in creating mundane design solutions. The confirmation bias limits engineers and engineering students inside an echo chamber, restricting their ability to think outside the box. Literature confirms that designers/engineering students fail to analyze problem statements effectively and start synthesizing them immediately. In essence, the analysis evaluates the needs and the design solutions, while synthesis consists of synergistically integrating ideas to create an innovative solution. The impact of analysis and synthesis training on design fixation is an unexplored area of research. It encouraged us to "determine whether there is a significant improvement in ideational capacity between engineering student participants before and after training." Although numerous strategies exist to reduce fixation, little information is available to aid their accuracy in the context of design creativity. In this context, this study seeks to reduce fixation and improve creative ideation by combining "training on analysis and synthesis."

In the study, 80 undergraduate students participated from multiple engineering colleges. The experiment consisted of two parts and involved two groups. First, a design task, "Design effective garbage bins," was given to group 1, and participants were encouraged to propose multiple designs. Then, the second group was given an analysis task, i.e., 'List down the pain points using a table fan'. Each group had 15 minutes to complete the task. After the task, participants were given 15 minutes of training on analysis (Painstorming), followed by 30 minutes on synthesis (SCAMPER strategy – a design heuristic). Post-training, the tasks in the first set were switched between the two groups, such that the group which carried out the analysis now carries out the synthesis. Subsequently, the participants' designs were scored for fluency, flexibility, and originality. Finally, the participants answered the need for a cognition scale (to check motivation and effort to think).

The data analysis reveals that the number of pain points listed and the ideation scores in each group were very low in the first session, compared to the substantially high scores in the second session, i.e., following 45 minutes of training. Though the main effect of SCAMPER training was on fluency (very high) and flexibility (high) scores, it also helped participants generate original/unique ideas. Further, the students who performed the task of synthesis post-training, painstorming helped them develop high-quality ideas while designing. A positive correlation had been noted between the need for cognition and fluency and flexibility scores. The results suggest a significant increase in motivation among the participants, thereby the high scores. The results also suggest that the participants who performed the analysis task understood the need and proposed better solutions.

In light of the current findings, the present work could further explore how the length of an analysis and synthesis training session affects ideation. Authors acknowledge the financial support from CSRI, DST through Grant No.: SR/CSRI/272/2016 to carry out this work.

The Effect of Stress on Abstract Reasoning

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Introduction:

Stress, especially acute stress, has a negative impact on cognition. We experience stress when our capacity and resources are not sufficient to meet environmental demands. The degree of stress may vary in different environments and/or due to individual differences in capacity. The stressors could be temporary (such as examination stress) or long term (that can be caused because of a conflicting environment). The duration and frequency of stress has a differential impact on an individual's mental as well as cognitive health.

The recent Covid-19 pandemic has been a great source of stress among the people. Due to the pandemic, many were under lockdown and under severe stress about the future and their livelihoods. This situation was quite novel for most people, resulting in many people experiencing stress. This stress could have been much more in case of students, especially those who would be attempting national competitive exams like NEET, JEE etc. as they had to go through both the general COVID related environmental stress, and also subjected to a constant change of exam schedules. Apart from this, there had been a lot of stress regarding their future colleges. Studies have shown the influence of stress on various cognitive processes, like perception, attention, creativity, and decision-making ability. While stress is largely shown to have a negative impact on cognition, some studies have demonstrated that mild state stress can improve cognitive functions such as memory, in some cases. However, very few studies have reported the impact of acute stress like pandemic on stressful cognitive task performances. The current study investigated the role of situational distress (caused by environmental change and demands) and transitory stress (temporarily caused by some tasks at hand) in abstract reasoning. We used DASS-12 (Depression Anxiety Stress Scale) to measure the individual distress associated with ongoing pandemic woes. For transitory stress, we used MIST (Montreal Imaging Stress Task). To measure the abstract reasoning, we used a standardized Advanced Raven's Progressive Matrices APM task.

Previous results from fMRI data shows that the time bar and the clock in MIST act as a stressor for the candidates. Therefore, it was hypothesized that individuals who would undergo MIST stress conditions may perform poorer in abstract reasoning tasks compared to the individuals who would undergo MIST no-stress condition because of varying experience of stress. It was expected that individuals who have reported psychological health issues, namely depression, anxiety, and stress, would show more impaired performance than those who have reported no-symptoms of any aforementioned psychological health concerns.

Method:

Participants

A total of 74 participants (mean 19.59, SD 2.7) completed all the tasks in the experiment. Those participants with total experiment time outside the interquartile range were considered as outliers and were removed. This resulted in a total of 68 participants of which 54 were male, 12 were female, one non-binary, and one preferred not to say.

Design

Our study followed a mixed-group design where participants were randomly assigned a condition for testing. T group denotes experimental condition consisting of 36 participants and U group denotes control condition consisting of 32 participants. We chose 12 puzzles from the APM puzzles - six pure visuo-spatial and six pure verbal-analytical. From this, 2 sets were made, with each set consisting of 3 questions from visuo-spatial and 3 questions from verbal analytical set. Each participant solved two sets of questions from APM (6 questions in each set). The two sets were counterbalanced across participants. Each trial began with a pre-set of APM puzzles followed by an intervention task, the Montreal Imaging Stress Task (MIST), which was followed by a post-set of APM puzzles. MIST comprises simple arithmetic problems to be solved with a set timer and fake feedback reporting the below-average

performance of the participant. In the control condition, there was no timer and feedback. After both the problem sets were answered, participants needed to answer a DASS-12 questionnaire set. The entire experiment was conducted online.

Results and Discussions:

DASS on the participants revealed that out of a total of 68 participants, 25 participants reported no symptoms of depression, 5 reported mild symptoms of depression, 14 moderate, 17 severe and 7 extremely severe symptoms of depression; on the anxiety scale, 33 reported no symptoms, 26 reported moderate, 6 severe and 3 reported extremely severe symptoms of anxiety; on the stress scale, 36 reported normal, 8 mild, 17 moderate, 6 severe and 1 reported extremely severe symptoms of stress. We observed a significant correlation between depression and stress (ρ=0.532, $p < 0.001$).

We performed the Shapiro-Wilk test of normality on the accuracy calculated as the difference of the correct score between pre-post APM tasks, and found the data was not normal ($p < 0.01$), and hence performed a Mann Whitney test to compare the two groups. We also performed a correlation analysis between the different dependent variables, pre-post correct score difference, depression, anxiety, and stress, and MIST accuracy.

The Mann Whitney test did not indicate any significant difference between the two conditions for the difference of the total correct score in the pre- and post- tests (Z=538.5, p=0.638, Effect Size=-0.065). We observed the median score for pre- and post- tests scores between the two MIST conditions to be 4. We did not observe any significant correlations between the test scores (in both the conditions) and any of the DASS sub scores.

The current results fail to reject the null-hypothesis against transitory stress condition. One plausible reason could be that the power for MIST induced stress required for the students from technical backgrounds (as we were interested in NEET and JEE) might be low and therefore require a larger sample size. It is also evident from the effect size, -0.065, that such a test might require a larger sample size to reject the null-hypothesis. Unlike previous studies, the current study had participants from mathematical background who could have found the MIST problem trivial and less stressful as compared to students with less/no mathematical background.

In line with previous findings, we observed a significant correlation between stress and depression. However, no significant correlation was observed between the components of DASS, and abstract reasoning scores.

For future studies, we can ask the participant to give a self-report of the stress experienced as they performed the stress task. We can also measure other physiological indicators of stress, as the participant performs the study. We can try this same experiment with other stress inducing intervention tasks, so that we can identify the best amount/type of stress to improve performance, without making the person too stressed that their performance is affected adversely. Such research would help us understand the effects of having standardized examinations during such stressful periods, and hence advocate for better stress management methods during standardized testing. Also, we can conduct the same experiment in a controlled setting (for example, in a lab) to reduce the random chance of errors.

Keywords:

Raven's Matrices; stress; anxiety; depression; abstract reasoning

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Investigation of Cognitive function and Brain Energy Metabolism in Mouse Model of Alzheimer's disease

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Introduction:
Alzheimer's disease (AD) is the most common neurodegenerative disorder associated with a gradual deterioration of cognitive functions, personality, and memory (Goedert and Spillantini 2006). Although AD was discovered more than a century ago, the biomarker for the diagnosis of the disease as well as the therapeutic intervention for the cure of the disease is not available. Glutamate (Glu) and gamma-aminobutyric acid (GABA) are the major excitatory and inhibitory neurotransmitters, respectively, in the mature mammalian central nervous system (Peters and Jones 1984). It is well established that a neuronal astrocytic substrate (glutamate-glutamine and GABA-glutamine) cycle exists in the brain. Although the human brain comprises only ~2% of the body weight, it accounts for ~20% of total oxygen utilization of the whole body indicating the overwhelming energy demands of the brain. Most of the energy utilized in the brain is used to sustain the processes associated with glutamate and GABA neurotransmission. These neurotransmitters are involved in many functions such as motor behavior, cognition and emotion, and are affected during the normal aging process and several neurological and neuropsychiatric disorders. Thus, the glutamate-GABA-glutamine axis is of major importance to brain function and cerebral well-being. We are investigating the pathophysiology of AD using genetic and chemical models. The major objective of the study is to evaluate cognitive function and neurometabolic activity associated with different cell types with the progress of AD that may result in identification of biomarker(s) for AD.

Methods:
All animal experiments were performed under approved protocols by the Institutional Animal Ethics Committee of CCMB. Genetics (APP-PS1 and APP-MAPT-PS1) and chemical (streptozotocin and aluminium chloride) mouse models were used in the study. The cognitive function is assessed by monitoring learning and memory using Morris Water Maze (Vorhees and Williams 2006) and the Novel Object recognition test (Bevins RA and Besheer 2006). Amyloid-beta plaque load was quantified using immunohistochemistry. For assessment of neuronal and astroglial metabolic activity, [1,6-13C2] glucose and sodium [2-13C] acetate, respectively, were infused in the lateral tail vein (Tiwari et al 2013). Blood was collected from the orbital sinus just before the end of the infusion, and the brain was frozen in situ in liquid nitrogen. Metabolites were extracted from the frozen brain tissue. The concentration and 13C labelling of brain metabolites were measured in tissue extracts using 1H-[13C]-NMR spectroscopy at 600 MHz NMR spectrometer (de Graaf et al 2003). Metabolism of [1,6-13C2] glucose via glutamatergic and GABAergic TCA cycles label GluC4 and GABAC2 during the first turn of the TCA cycle. Labelling of GlnC4 occurs from GluC4 and GABAC2 via glutamate-glutamine and GABA-glutamine cycle. [2-13C] Acetate is selectively transported and metabolized in astroglia, and labels GlnC4. Neurotransmitters GluC4 and GABAC2 are labelled via glutamate-glutamine and GABA-glutamine substrates cycling between astroglia and neurons. Cerebral metabolic fluxes were obtained by analysis of 13C turnover of brain amino acids using a three-compartment metabolic model (Patel et al 2005; 2018).

Results and Discussions:
Our analysis in APP-PS1 mice indicated that the neuronal metabolic activity is decreased while the astroglial function is increased with the progress of AD. Moreover, neurometabolic changes precede neurodegeneration and clinical symptom in AD. Similar observations were made in triple transgenic (APP-MPAT-PS1) mice. To understand the pathophysiology in sporadic AD, we investigated memory and neurometabolism in mice after intracerebroventricular injections of streptozotocin or chronic aluminium chloride treatment. Mice treated with streptozotocin and aluminium chloride exhibited cognitive and neurometabolic deficits similar to transgenic mice. Our gender-based study indicated that

cognitive function and neurometabolism are preserved in transgenic female mice until their reproductive age. However, the number of Aβ plaques in the brain of transgenic female mice is more than males. This together with no perturbation in cognitive function and cerebral metabolism in females suggests that Aβ-plaque load does not represent the AD pathology. Additionally, we have shown that interventions involving riluzole, Withania Somnifera, and dietary restriction alleviate cognitive function and neurometabolic activity in transgenic mice. The study will provide a brief overview of these investigations.

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Acknowledgments:

The study was supported by funding from the Council for Scientific Industrial Research: CSIR-CCMB (NCP/MLP0139) and network project (BSC0208), and Cognitive Science Research Initiative Task Force of Department of Science and Technology, Government of India (DST/CSRI/2017/258).

Effect of Nature Experience on Fronto- Parietal Correlates of Neurocognitive Processes: An ERP Study

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Background:
Several studies have demonstrated that brief interactions with natural environments can improve cognitive functioning. However, the neurocognitive processes that are affected by natural surroundings are not yet fully understood. It is argued that the "elements" in natural environment evoke "effortless" involuntary attention and may affect the neural mechanisms underlying inhibition control central to directed attention.

Methods:
The present study used electroencephalography (EEG) to investigate the effects of nature experience on neurocognitive processes involved in directed attention. During EEG recordings, participants (n = 53) were presented nature audio/video as stimuli to evoke nature experience, and flanker task was administered both before and after nature experience. An open eye rest condition was included randomly in either before or after nature experience cognitive task as a control condition.

Results:
The event-related potential analysis demonstrated a significant improvement in the response time after the nature experience. The analysis also demonstrated a significant difference for the inhibitory control process in fronto-parietal N2 ($P < .01$) and P3 ($P < .05$) for incongruent trials subsequent to nature experience. The spectral analysis also found an increase in alpha in all five brain regions (all $Ps < .01$) and fronto-central theta power ($P < .01$).

Conclusion:
The findings suggest that improved inhibitory control processes could be one of the aspects of enhanced directed attention after nature experience. Increased alpha along with theta indicates a relaxed yet alert state of mind after nature experience.

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