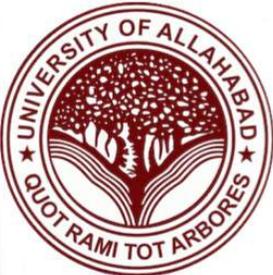


Issue 1 & 2, October 2018

# CBCS NEWSLETTER



## About CBCS



**Prof. Bhoomika.R.Kar,  
Head, CBCS**

The Centre of Behavioural and Cognitive Sciences is a pioneer in developing the discipline of Cognitive Science in India. The MSc and PhD programs in Cognitive Science at the Centre have been running successfully since the past 16 years. Students at CBCS come from varied disciplines like Psychology, Computer Science, Engineering, Zoology/life sciences and have made a very good career in the field of Cognitive Science. The Centre has developed infrastructure for research and training with the support of the UGC. In addition Department of Science and Technology and Department of Biotechnology have also provided consistent support for the research activities at the Centre. The Centre is equipped with labs for cognitive neuroscience research with EEG/ERP systems, Transcranial magnetic stimulation and the upcoming National Neuroimaging facility and the Primate Neurophysiology Lab. The Centre has been awarded with a large-scale grant by the DST to develop the National Neuroimaging Facility, which would be the first of its kind in a University set up. Faculty and students at CBCS have been working in multiple research areas including basic research on processes like attention, visual perception, consciousness, cooperation, emotions, decision making, action control, cognitive development and language processing as well as a combination of basic and applied research on meditation, cognitive disorders (ADHD, Dyslexia, Autism, anxiety disorders) and so on. The Centre has been organizing International conferences, outreach activities including workshops on dyslexia and autism and memory camp for the elderly. We are in the process of establishing an outreach Centre with consultancy services including cognitive-neuropsychological assessment and intervention. Our students have been successful in securing doctoral/postdoctoral positions in prestigious institutions across the globe. Our students have also been placed as faculty members in many IITs in the country. Some of our students are also placed in the Industry particularly pertaining to human computer interaction, user experience and design after their Masters/PhD in Cognitive Science. We are determined to build the Centre further for research, training, applications and outreach activities relevant to Cognitive Science. Newsletter is a medium to disseminate information about the Centre's activities and events. The last newsletter was a print version named "Manas" in 2015 and we are reinstating the same in the name of CBCS Newsletter (e- newsletter) with two issues in a year.

## Message from Prof. Janak Pandey



### **Prof. Janak Pandey**

Founder Head, CBCS,  
ICSSR National Fellow.

The Centre of Behavioural and Cognitive Sciences (CBCS) is the first academic Centre or Department with Master program founded in 2002 at the University of Allahabad, India. The Centre launched Master Program in its first year and with joining of regular faculty Doctoral Program was started. The faculty of the Centre has been working diligently with students and research scholars leading to quality publications, and placement of students in the best institutions worldwide for higher studies, on jobs, and as Post-Doctoral Fellow. For example , recently our Ph Ds have joined as faculty in IITs (Indian Institute of Technology) and couple of months ago Dr. Maruti Mishra a recent Ph D joined Harvard as a Post-Doctoral Fellow. The faculty members are internationally recognized. Gradually, a number of IITs and other institutions have started or planning to establish cognitive science program. The Department of Science and Technology, Government of India has been very supportive for the development of cognitive science and with their support with a large scale grant the fMRI facility is getting installed at CBCS. This is exciting opportunity for CBCS and cognitive science program nationally. This is the right occasion to upgrade this CBCS as the UGC Inter –University Centre for Mind and Brain Sciences to maximize the use of this facility by the scientists of all institutions . The CBCS is an institution of UGC. We thank UGC for their support and look forward to them for further support to upgrade the Centre. I would like to suggest some new initiatives for achieving the goal of applications of cognitive science knowledge to help individuals, society at large and to work with interfacing other sciences for advancement of new technologies . For example, we all are familiar with cognitive and behavioural disorders (ADHD, Autism, Dyslexia) particularly in children and memory disorders in older adults. CBCS has been actively engaged in various outreach programs and training teachers and parents and organizing memory camps. The role of Cognitive Science in Artificial Intelligence and human factor engineering are well known. This is the high time to introduce specialization in the master program so that the CBCS is able to train people who would work at applied level and give back to the society in many ways. I would like to wish all the best to Prof Bhoomika Kar who took over as head of the CBCS in March, 2018. We are sure that her leadership will help the Centre to develop new applied programs. May I also volunteer to work for the advancement of the Centre and particularly in the out-reach programs.

## Events 2015 – 2018

### International Conference on Emotion and Cognition, 14–16th Dec, 2015

There is growing interest and research in the role played by affective processes in cognition. Numerous studies have shown that emotions and multiple cognitive processes interact and influence one another. This was the motivation for organizing the International Conference on Emotion and Cognition, which explored interdisciplinary research on Emotion and



its relationship with Attention, Memory, Decision making, Affective control, Affective and cognitive development and disorders. The conference was held from 14th to 16th December in 2015 at Centre of Behavioural and Cognitive Sciences, University of Allahabad. Prominent speakers attended it from India and abroad, including Dr. Luiz Pessoa (University of Maryland, USA), Dr. Mark Fenske (University of Guelph, Canada), Dr. Michaela Riediger (Max Planck Institute of Human Development, Germany) and many others. Young scientists also got the opportunity to present their work on emotion and cognition in the form of oral and poster presentations.

### Annual Convention of National Academy of Psychology, 2–5th Feb, 2016

National Academy of Psychology (NAOP) is a professional organization that aims to foster the growth and development of Psychology as a science and profession in India. It organizes an annual convention to provide an opportunity to young researchers to share their work and learn more about emerging field in Psychology. The 25th Annual Convention was held from 2nd to 5th February in 2016 at University of Allahabad, which was jointly organized by the Department of Psychology and Centre of Behavioural and Cognitive Sciences. The focus of this convention was to understand and promote interdisciplinary research in psychological fields.



Some topics and themes for the conference were:

1. Interface between psychology and other sciences
2. Understanding the convergence between cognitive, affective, motivational and interpersonal processes
3. Human strengths & environment.
4. Role of family, ethnicity, culture and spirituality in human existence
5. Health, subjective well-being and personal development
6. Exploring the philosophical assumptions underlying integrative psychological science
7. Development of new techniques and approaches to investigate psychological phenomena.

The event was chaired by Susan H. McDaniel, the President of American Psychological Association. Over 400 students, researchers and teachers from diverse fields in Psychology attended and participated in the Convention, making it a huge success.

## GIAN Time Perception, 1–15th March, 2016

Global Initiative of Academic Networks (GIAN) is an initiative taken by the Government of India to promote growth and development in scientific fields by tapping into international pool of distinguished scientists. Centre of Behavioural and Cognitive Sciences organized a GIAN course on Time Perception from 1st to 15th March, 2016. The aim of the course was to learn more about how people perceive time, developmental changes in time perception, the subjectivity and context dependent perception of time, neural processes involved in time perception and how time perception is related to other processes such as, attention, memory and emotion. The lectures in the course were complemented with laboratory sessions where participants gained hands-on experience of some of the classic and modern methods for studying time perception. The course was jointly taught by Professor Narayanan Srinivasan from CBCS and Professor John Wearden, Emeritus Professor of Psychology at the University of Keele in U.K.



## GIAN Science of Consciousness and Meditation, 5–16th December, 2016

The second GIAN course, organized by Centre of Behavioural and Cognitive Science, was on the science of two emerging fields, Consciousness and Meditation, which was held from 5th to 16th December, 2016.

Consciousness is considered to be one of the fundamental problems in philosophy and science, mostly due to lack of proper methodologies to study it. However, in the past 30 years, consciousness research has gained prominence in cognitive science and neuroscience. The course aimed to provide an introduction to the science of consciousness and covered multiple methodologies and different theoretical approaches used to study and understand consciousness.



Another topic of this GIAN course was 'Meditation' which is an established practice of mental training for thousands of years in Asia. Scientific study of meditation has grown significantly in the last twenty years. The course's objective was to look into the cognitive and neural changes that occur due to the practice of meditation as well as the effects of meditation on wellbeing. Meditation also provides us a way to study a person's experience, which can be used to understand consciousness. The course addressed issues related to the study of consciousness using meditation as a tool.

The course was jointly taught by Dr Narayanan Srinivasan, Professor at Centre of Behavioural and Cognitive Science and Dr. Antonino Raffone, Associate Professor of Psychology at Sapienza University of Rome.

## Memory Camp, 16th September, 2017



There has been a rapid increase in the aging population worldwide and in India. Aging is accompanied by various kinds of degeneration in our body and is prominently reflected in our motor and cognitive capabilities. Sometimes, these degradations are a precursor for Alzheimer's and Parkinson's disease; the two most common neurodegenerative disorders manifested in middle to old age. Usually, they are diagnosed once they have progressed substantially, probably because of lack of awareness among people. But if detected earlier, it could help both the patient as well as the family to look for treatment and counselling options.

There are many standardized and robust neuropsychological test available which are widely used to assess general cognitive functioning like learning, memory, visual perception etc. The idea is to use these tools to evaluate cognitive health which might help in early detection of disorders like dementia. A drive to implement this was initiated by CBCS via 'Memory camp' on 16th September 2017. People in the age group of 35-75yrs were invited to participate and get a complete evaluation of memory and general cognitive health. About 30 participants registered for the camp and a detailed cognitive and memory assessment was conducted for each participant and they were given a comprehensive report and counseling explaining the report.

It is intended to be an outreach initiative of CBCS for screening age related problems in memory and cognition. Further it also intends to to enhance awareness about early identification of age related cognitive decline. Cognitive aging is also one of the important areas of research interest of the Centre.

## Brain Bee, 20th January, 2018



Brain Bee is a non-profit neuroscience quiz for high school students conducted in various countries across the world. It is an attempt to motivate students to learn about the brain and inspire them to pursue careers in brain research. In Allahabad, Centre of Behavioral and Cognitive Sciences (CBCS) has been hosting this competition since 2013. This year, thirty two students from 17 schools and colleges from Allahabad participated in the event. The technical team included Prof. Bhoomika R. Kar and PhD scholars Richa Nigam, Garima Joshi, Sarvanan Priyan and Master's students Akanksha, Achint, Tripti, Nithin, Mahek, Abhilasha, Christelle, Priyanka, Ishan, Saurabh, Sanchita and Parvathy. Parents and teachers of students were also invited.

The competition consisted of a written test followed by an oral round consisting of three phases. Prof. Janak Pandey, founder head of CBCS, former Vice Chancellor of the Central University of Bihar, and currently a National fellow of ICSSR spoke about the rapid emergence of the brain sciences and encouraged the students to pursue their careers in neuroscience. The judges this year were Dr. K. P Singh, Department of Zoology, University of Allahabad and Dr. Chhitij Srivastava, Department of Psychiatry, MLN Medical College, Allahabad. The 2018 Allahabad Regional Brain Bee winner is Ms Saumya Chaubey from St. Mary's Convent, Allahabad. The first runner-up is Supriya Patel from BBS Convent. The second runner-up is Rohit Verma from MV Convent. Ms Saumya Chaubey participated in the national-level competition held in Cochin in May, 2018.

## International Conference on Meditation, 4–6th March, 2018



The International Conference on Meditation was organized at CBCS with an aim of discussing and sharing recent developments in meditation science. Prominent scientist from different countries participated in the conference. Prof. B.N Gangadhar, director of NIMHANS (National Institute of Mental Health and Neuro-Sciences), Bangalore, in his opening remarks emphasized in the clinical implication of meditation.

The conference was attended by the likes of, Dr. Patricia Jennings from University of Virginia, who spoke about CARE (Cultivating Awareness and Resilience in Education), a professional developmental program that combines mindful awareness and compassion practices to help teachers deal with the challenging atmosphere of the classroom. Prof. Stephen Anthony Parker, from Saint Mary's University of Minnesota, USA, discussed the benefits of Yoga-Nidra. He also conducted a meditation session with the participants. Prof. Tal Dotan Ben-Soussan from Patrizio Paoletti Foundation, Italy, discussed the effects of meditation on clinical conditions like dyslexia. Prof. Narayanan Srinivasan from CBCS highlighted the effects of meditation on attention and perception.

## **DALI Workshop, 7th-8th September, 2018**



Dyslexia is a specific learning disability wherein children do not achieve adequate reading skills. Dyslexia is believed to have an alarming incidence of 5-10 percent of school-going children worldwide. Dyslexia Assessment for languages of India (DALI) is the first standardized and validated screening and assessment tool in four Indian Languages: Hindi, Marathi, Kannada and English and is being validated in other Indian languages. DALI is developed by National Brain Research Centre (NBRC), Manesar, Haryana and validated at five Centres in India including National Brain Research Centre, Orkids Foundation, New Delhi, CBCS, AU, Maharashtra Dyslexia Association, Mumbai, All India Institute of Speech and Hearing, Mysore and Dr. Shanta Vaidya Memorial Foundation, Pune. This project was led by Prof. Nandini C. Singh, NBRC, and funded by the Department of Science and Technology, Government of India.

A training workshop on Dyslexia Assessment for Languages of India (DALI) was organized by CBCS on September 7-8, 2018. The aim of the workshop was to train the teachers with the administration and scoring of the junior (grades 1-2) and Middle (Grades 3-5) Screening tool for dyslexia, and to train Clinical Psychologists, Speech pathologists/therapists, Special educators, School counselors with the administration, scoring, profiling and interpretation of the assessment battery and screening tool for identification of children at risk for dyslexia. A total of 40 participants registered for the workshop out of which 37 attended including teachers, psychologists, counselors, speech therapists and special educators. Resource persons for the workshop included Dr. Geet Oberoi, President, Orkids Foundation, New Delhi and Prof. Bhoomika R. Kar, CBCS.

The first day focused on the demonstration of the administration and scoring of the Screening tool in Hindi and English along with the introductory talks on learning disability, dyslexia, neurocognitive mechanisms and assessment. The day ended with hands-on session with the screening tool. The second day of the workshop focused on the demonstration of the administration and scoring of the Language Assessment Battery in Hindi and English language, profiling and interpretation of the Language Assessment Battery and Remediation guidelines for Dyslexia. The day ended with hands-on session with Language Assessment Battery for participants. Fourteen schools were equipped with the Screening tool.

## Memory Camp, 7th October, 2018



The Centre organized the second Memory Camp, an outreach initiative for screening of memory and cognition related problems due to aging on October 7th, 2018. This camp was set up to assess and provide a detailed record of memory and general cognitive functions through formal evaluation including assessment of learning and memory, attention, working memory span, anxiety and emotion regulation along with screening measures (objective measures and subjective complaints of memory and general cognitive abilities related day to day activities) for mild cognitive impairment and dementia. A total of 24 participants in the age group of 40-75 years registered for the memory camp out of which 17 participated in it. All the participants got a complete evaluation of their memory and general cognitive health through an assessment conducted by individual assessors in the respective labs for about 60-90 minutes. Each participant was provided a detailed report with individual feedback. CBCS will continue to organize such outreach activities in future for awareness related to cognitive aging. The camp was organized under the supervision of Prof. Bhoomika R. Kar who was assisted by a technical team of PhD scholars Richa Nigam, Garima Joshi and Tripti Verma and students of M.Sc Cognitive Science. Mr. Puneet Srivastava (Administrative officer, CBCS) assisted with administrative help during the camp.

### Interesting Video

Dr. Anil Seth is a professor at University of Sussex, UK. This is an interesting link to his TED talks video where he discusses how our conscious experiences are generated.



## Invited Talks



**Dr. Srikanth Padmala**

University of Maryland, USA

Title: *Interaction between Emotion Motivation and Cognition in the Human Brain*

Date: 21st March, 2018



**Dr. Anil Seth**

Professor, Cognitive and Computational Neuroscience

University of Sussex, UK

Title: *Predictive processing and perceptual phenomenology*

Date: 23rd April 2018



**Dr. Srikanth Dandotkar**

Assistant Professor, Department of Psychology

University of Southern Indiana, USA

Title: *Student's evaluation of arguments: what, why and how*

Date: 8th June, 2018

## Upcoming Events – 2018

### 17th Foundation Day Ceremony and Foundation Day Lecture, 28th October, 2018

Centre of Behavioral and Cognitive Sciences, University of Allahabad is going to celebrate its 17th Foundation day on October, 28th 2018. The Centre was set up by the University Grants Commission as a centre of excellence at University of Allahabad in 2002. It started cognitive science research in India and has been committed to enhance the knowledge of mind and brain sciences. The classes for the first batch of Masters in Cognitive Science started on October 28th, 2002 which marks the foundation day of the centre. Every year to celebrate this occasion the centre organizes lectures by eminent psychologists, cognitive scientist, philosophers and neuroscientists. This year's foundation day lecture will be delivered by Prof. Aditya Murthy, Indian Institute of Science (IISc), Bangalore. Prof. Murthy leads a team of researchers at IISc who study primate brain and are trying to understand how visual information is processed in the nervous system and converted into motor behavior. The title of his talk is "Neural Control of Sequential Movements".



### GIAN course: Developmental Cognitive Neuroscience, 10th-22nd December, 2018

After organizing two successful GIAN courses on Time Perception and on Science of Meditation and consciousness in 2016, the centre will be organizing the third GIAN course from December 10th to 22nd, 2018 on Developmental Cognitive Neuroscience. Dr. Chandan Vaidya, Professor and Chair in the Department of Psychology at Georgetown University, Washington DC will be the course instructor and Prof. Bhoomika R. Kar from CBCS will be the course coordinator. The course content is organized into 4 modules, the first two providing foundational knowledge about brain development and methods and the last two on self-regulation, its typical development and how it is affected in ADHD and Autism. This course will introduce students to the key concepts in brain imaging methods, and current research on brain and its functional development. Key themes of discussion at each stage will be developmental trajectories and timing, representation, plasticity and normal and abnormal development. Particular emphasis will be placed on the use of noninvasive brain imaging methodologies such as fMRI, fNIRS, and EEG for probing the brain and function across development, from the prenatal period to adolescence.



## Welcome New People

### Faculty Member



**Dr. Niharika Singh, Assistant Professor**

Dr. Singh received her PhD and Master's degree in Cognitive Science from the Centre of Behavioural and Cognitive Sciences, University of Allahabad. Her research area includes language processing and cognitive control in bilinguals. Currently, she is interested in investigating multimodal interactions during language processing using eye tracking methodology, embodied language processing, and pupillometry. She is teaching courses like Psycholinguistics, Culture and Cognition, Language and cognition, and Methods in Cognitive Science.

### New Post Doctoral Fellows



**Dr. Saraswati Yadav**

Dr. Saraswati Yadav is working on the project on Resting EEG and ERP in the context of modulations in cognitive control among high, medium and low trait anxious individuals. She is interested in doing research on psychophysiological parameters, and apart from research she also is involved in teaching Neuroscience for postgraduates.



**Amrendra Singh**

In his PhD dissertation, Amrendra has focused on understanding the mechanisms involved in visual and temporal perceptual experience, and how it is influenced by long term practice of concentrative meditation. In continuation to his PhD work, the focus of his current research is to investigate and understand the effects of different meditation practices in improving cognition using behavioral and neuroimaging methodology. He is also interested in studying the relationship between meditation and moral cognition.

### D.Phil. Students 2017-batch



**Ankit Gupta**

Ankit is working with Prof. Narayanan Srinivasan as his supervisor. His thesis will be focused on affective cognitive domains of compassion. He did his B.Sc. in Yoga Sciences and Human Consciousness from Dev Sanskriti Viswavidyalaya, M.Sc. in Yoga Sciences from University of Patanjali, Haridwar.

**Shilpi Bhardwaj**

Shilpi has joined as a graduate student with Prof. Narayanan Srinivasan. Her thesis will be focused on mind wandering, metacognition and meditation. She did her bachelor's in Life sciences from MJP Rohilkhand University, and master's in Cognitive science from CBCS, University of Allahabad.

**Swati Kushwaha**

Swati has joined PhD studentship with Dr. Niharika Singh. Her research interest includes speech conceptualization and attention. She did her B.A. in Psychology & English Lit. from Allahabad Degree College, University of Allahabad, and M.Sc. in Cognitive Science from CBCS, University of Allahabad.

**New Research Assistants****Ouroz Khan**

Ouroz has joined as a research assistant with Dr. Supriya Ray and is interested in understanding the neural mechanisms of decision making. More specifically, she studies how neural mechanisms enable us to select a particular target when similar options are available, and how we plan a response in the direction of the target simultaneously, even when execution of the response is uncertain.

**Trisha Dutta**

Trisha's primary focus is to understand the psychological processes underlying moral decision making. She is interested in understanding what makes people 'good' or 'bad' and how different factors such as religion, mental representations, environment, etc, affect such judgments and behaviors. She is currently working as a Research Assistant on a project on 'Religion and Decision Making', under Prof. Narayanan Srinivasan's supervision.

**M.Sc. 2018 Batch**

## Congratulations!

### Recent PhD Graduates



#### Dr. Abhilasha

Abhilasha defended her doctoral thesis, titled “Online comprehension of Verbs in Hindi-English Bilinguals,” on 18th November 2017.



#### Dr. Maruti Mishra

Maruti defended her doctoral thesis, titled “Attention and Emotion Appearance,” on 1st May 2018.

### NET Qualifiers 2017-18

1. Pragya Pandey, PhD Student
2. Garima Joshi, PhD Student
3. Ankit Gupta, PhD Student
4. Ishan Singhal, M.Sc. 2016–18
5. Diksha Gautam, M.Sc. 2016–18
6. Nithin T.H, M.Sc. 2016–18
7. Parvathy Ramesh, M.Sc. 2017–19

## Placements

### Postdoctoral Positions

1. Dr. Debarati Bandopadhyaya: Bernoulli Institute for mathematics, Computer Science and Artificial Intelligence, University of Groningen, Netherlands
2. Dr. Maruti Mishra: Boston Attention and Learning Lab, Boston, USA, in collaboration with Harvard Medical School.

### PhD programmes

1. Shamini Vardha: Humanities and Social Sciences, IIT Bombay
2. Rampriya Darshini: Center for Cognitive Science, IIT Kanpur
3. Shubham Pandey: Humanities and Social Sciences, IIT Bombay
4. Abhishek Navaria, NBRC, India
5. Mohd Asif, IIIT Allahabad
6. Rujuta Pradhan: Humanities and Social Sciences, IIT Kanpur
7. Praveen, K. Kenderla, Boston University, USA
8. Bolaram Anudeep, Auburn University, USA
9. Srishti Tripathi, Kyoto University, Japan
10. Priyanka Tamuly, Amity Institute of Psychology and Applied Sciences, Amity University

### In the Industry

1. Dr. Abhilasha Srivastava, Research Engineer, Siemens Bangalore
2. Dr. Asma Hanif, ITC, Bangalore
3. Dr. Aparajita Ranjan, Quantitative Researcher, Facebook, USA
4. Ms. Smriti Kesarwani, User Experience Expert, Outsystems, Singapore

5. Ms. Srishti Dang, Research Engineer, Siemens Bangalore
6. Ms. Nupur Labh, Xerox International (current) and UX design, Bangalore
7. Ms. Diksha Gautam, UX Researcher, Peepaldesign, Bangalore

### **Research Assistant positions**

1. Akanksha Malik, Center for Cognitive Science, IIT Kanpur
2. Saurabh Ranjan: HBCSE-TIFR (Homi Bhabha Centre for Science Education), Mumbai
3. Ouroz Khan, CBCS, Allahabad
4. Trisha Dutta, CBCS, Allahabad

### **Eye Movement and Action Control Lab**

One of the key functions of central nervous system is to generate co-ordinated movements in response to or in anticipation of the changing environment. Eye movement research has produced numerous insights into understanding movement control and cognition. In our lab, we study problems like how cognitive processes e.g. attention, perception etc. shape our saccadic eye movement (action) control and vice-versa, dynamics of target and action (saccade) selection, perceptual decision making and so on. We use video-based infrared non-invasive eye trackers to measure the saccadic eye-movements and pupil size precisely while participants perform experimental tasks. We also record EEG signal from human participants. A non-human primate research facility for recoding neuron's activity is under construction. Computational models are designed based on empirical findings. The future aim of the lab is to combine the eye tracking with other methods e.g. EEG, single cell recording, simulations to better understand and address the present challenges in movement control and underlying physiology.

## Research Articles



### Does the bounded rationality of agents help to establish conditional cooperation?

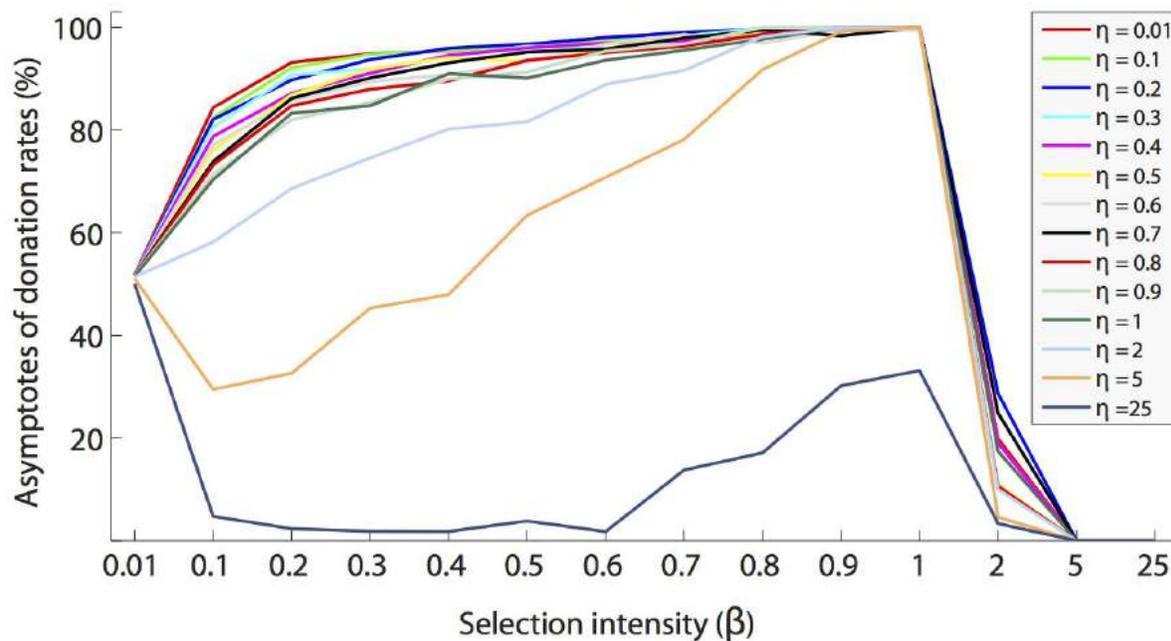
Balaraju Battu,

Centre of Behavioural and Cognitive Sciences, University of Allahabad.

Suppose, you are in a new city and somebody asked for a help, do you help a random met agent, if there is no chance of meeting that agent again and no interaction history of that agent is available to you, but you only know how generous the population is (all you know is what was the cooperation level of the city). However, helping somebody may cost you a little, but may provide a greater benefit to the receiver. Clearly, unless somebody returns for one's help, helping a random met agent is not at all a rational decision. A rational agent could do is take the help and never return the help. If everybody behaves rationally, will ever the society can establish cooperation? What about a population consists of heterogeneous conditional agents, are the agents establish cooperation when they are bump into each other as strangers?

Let us consider a population which consists of heterogeneous agents, i.e., each agent born with unique CCC value. The agent's CCC value determines the agent's cooperative behaviour. A conditional agent helps a random met agent if and only if the number of donations in the past more than the agent's conditional cooperative criterion (CCC) (a conditional cooperative rule). Let us set up the problem in evolutionary settings and ask, does the population consisting of heterogeneous conditional agents ever establish cooperation? Agents interaction set up: each agent in the population acts either as a donor or as a receiver with equal probability (call it as a generation). If a donor cooperates with a potential receiver, the donor incurs a cost,  $c$  and the receiver gains a benefit,  $b$  ( $b > c$ ). We start with an initial population with a small number of donations before the agents start to interact with each other. Clearly, an agent with lower CCC value (the agent requires few number donations) donates more frequently and scores less than the agent with high CCC value and scores more (requires more number of donations). After each generation, each agent updates its CCC value, which depends on relative cumulative payoff difference of randomly matched agent. Population update: the lower payoff score agent imitates the higher payoff agent's CCC value more often. Clearly, after a few generations, the population gradually dominates with high CCC agents and these agents do not cooperate as there are not enough donations in the population. It appears that no cooperation is established in the world of ideal conditional agents as the evolution selects selfish agents, but we observe that agents cooperate often when you ask for help? How is it possible? Maybe the agents are not ideal agents due to bounded rationality. It turns out that when agents are not operating with a strict conditional rule and not imitating successful agents' social behaviour, occasionally, the population consisting of heterogeneous conditional agents can establish high levels of cooperation (Battu, Pammi, & Srinivasan, 2018). It seems social systems require certain levels of flexibility, not the strict rules, to function cooperatively.

In the figure shown below, the asymptotes of donation rates for each  $\eta$  and various  $\beta$  are depicted. The population size = 100 and each agent CCC value is drawn from uniform distribution [1, 95].



Suppose the parameters  $\beta$  controls the occasional mistakes in conditional cooperative decisions and parameter  $\eta$  governs occasional imitating mistakes. When  $0.1 < \beta < 1$  and  $0.1 < \eta < 1$  the population can establish more than 85% cooperation.

#### Source Article

[1] Battu, B., Pammi, V. S. C., & Srinivasan, N. (2018). Evolution of Cooperation with Heterogeneous Conditional Cooperators. *Scientific Reports*, 8(1), 4524. <https://doi.org/10.1038/s41598-018-22593-2>



### Does intention alter subjective time?

Mukesh Makwana

Centre of Behavioural and Cognitive Sciences, University of Allahabad.

In this dynamic world, events occur either in accordance with one's desire (intended events) or not (unintended events). But does our subjective time change as a function of intention? A recent study published in *Scientific Reports* investigated this question.

The study involved series of experiments aimed to understand whether seeing an intended object influences our sense of time and if yes then what would be its underlying mechanism. A simple color choice task was designed to manipulate intention. Participants were asked to choose which color circle they intend to see and randomly in half of the trials they were shown the circle in intended color and in other half they were shown the circle in unintended color. Irrespective of

the color of the circle participants were asked to report for how long the circle appeared on the screen. Results showed that participants perceived the duration of the circle to be longer when it appeared in intended color compared to unintended color. This temporal expansion due to intention was termed as intention-induced temporal expansion (IITE). IITE was explained using the pre-activation account, which suggests that when one intends about a particular outcome, the corresponding representation gets activated, and this pre-activated representation is processed faster and reaches the awareness earlier compared to unintended outcome leading to extended temporal experience.

If intention pre-activates the representation then the next logical question was “for how long” the intention-induced representation remains active and influence the perceived time. Towards this aim, across three experiments the time delay between the intentional action and the appearance of the circle was manipulated from 250ms (Exp1), 500ms (Exp2) to 1000ms (Exp3). Results showed that the IITE was present for 250ms and 500ms delay but not for 1000ms delay, suggesting that the intention-activated representation fades away as the delay increases to 1sec. If pre-activation of representation influences time perception then the next question was whether all type of pre-activations will influence time perception in similar manner or this effect is specific for intention-induced pre-activation. To address this question another experiment was designed in which participant instead of intending were asked to see the color word (prime) on the screen and press a corresponding key. Note that the prime served two purposes, first, it led to cue-based activation of representation and second, it prevented the participant to make a self-selected choice rather it forced them to perform instruction-based action. Results showed no difference in perceived duration between prime-congruent vs. prime-incongruent events, suggesting that intention plays an importance role in IITE.

The final question addressed in the article was with respect to the mechanism via which intention influences time perception. This was evaluated in terms of which component of “internal clock model” does intention influence. If intention affects the pacemaker speed, then the temporal expansion should increase in multiplicative manner giving a “slope-effect”, and if it affects the switch component then the temporal expansion should increase in the additive manner and “no slope-effect” should be observed. Results did not show slope-effect, indicating that intention might influence the switch/gating component of the “internal clock model” rather than the pacemaker speed. In summary, this study provides convincing evidence that intention does expand subjective time in millisecond range. These findings have implications for theories of time perception and intentional binding. With respect to time perception, this study also demonstrates that what we see is not only affected by what our eyes actually see but also by what our mind wants to see.

#### **Source Article**

[1] Makwana, M., & Srinivasan, N. (2017). Intended outcome expands in time. *Scientific Reports*, 7(6305).

## Achievements

### Research Grants

1. Prof. Bhoomika R. Kar: A three years Department of Science and Technology (DST) grant for the project titled 'Dynamic adjustments in control EEG characterization of anxiety and its effect on cognitive control'.
2. Dr. Niharika Singh: A three years Department of Science and Technology (DST) grant for the project titled 'Age related differences in prediction in language comprehension'.
3. A large-scale grant from DST to develop the National Neuroimaging facility, which will be the first of its kind in a University set up. Building is underway and will house an fMRI scanner and labs for faculty and students interested in cognitive neuroscience. This facility will be used to conduct state of the art research on basic and applied aspects of neural underpinnings of cognition. We intend to conduct studies on brain mechanisms of attention, emotion, time perception, language processing, cognitive development, actions and decision-making.
4. DST has sanctioned a grant: Fund for Improvement of science and technology infrastructure in universities & higher educational institutions (FIST). This is to strengthen the post-graduate teaching and research facilities in the department. This grant also includes a research project on 'Effects of aging on brain, cognition and affective regulation'.

### Publications

1. Battu, B., Pammi, V. S. C., & Srinivasan, N. (2018). Evolution of cooperation with heterogeneous conditional cooperators. *Scientific Reports*, 8:4524
2. Kar, B. R., Srinivasan, N., Nehabala, Y., & Nigam, R. (2018). Proactive and reactive control depends on emotional valence: A Stroop study with emotional expressions and words. *Cognition & Emotion*, 32, 325-340
3. von Mühlénen, A., Bellaera, L., Singh, A., & Srinivasan, N. (in press). The effect of sadness on global-local processing. *Attention, Perception & Psychophysics*.
4. Makwana, N., & Srinivasan, N. (2017). Intended outcome expands in time. *Scientific Reports*, 7:6305.
5. Naik, S., Banerjee, A., Bapi, R. S., Deco, G., & Roy, D. (2017). Metastability in Senescence. *Trends in Cognitive Sciences*, 21(7), 509-521.
6. Pammi, V. S. C., Ruiz, S., Lee, S., Noussair, C., & Sitaram, R. (2017). The effect of wealth shocks on loss aversion: behavior and neural correlates. *Frontiers in Neuroscience* (Section: Decision Neuroscience).
7. Srivastava, N., & Srinivasan, N. (2017). Intertemporal impulsivity can also arise from persistent failure of long-term plans. *Behavioral and Brain Sciences*, 40.
8. Kumar, D., & Srinivasan, N. (2017). How multi-scale control structures sense of agency: Investigating intentional binding using event-control approach. *Consciousness and Cognition*, 49, 1-14.
9. Bouwmeester, S., Verkoeijen, P. P. J. L., Aczel, B., . . . , Srinivasan, N., . . . , & Wollbrant, C. E. (2017). Registered Replication Report: Rand, Greene & Nowak (2012). *Perspectives on Psychological Science*, 12(3), 527-542.
10. Mukherjee, S., Sahay, A., Pammi, V. S. C., & Srinivasan, N. (2017). Is loss-aversion magnitude-dependent? Measuring prospective affective judgments regarding gains and losses. *Judgment and Decision Making*, 12(1), 81-89.
11. Raffone, A., & Srinivasan, N. (2017). Mindfulness and cognitive functions: Toward a unifying neurocognitive framework. *Mindfulness*, 8, 1-9.
12. Srinivasan, N., & Singh, A. (2017). Concentrative meditation influences visual awareness: A study with color afterimages. *Mindfulness*, 8, 17-26.

13. Becker, J.C., Butz, D.A., Sibley, C.G., Barlow, F.K., Bitacola, L., Christ, O., Khan, S., Leong, C.H., Pehrson, S., Srinivasan, N., Sulz, A., Tausch, N., Urbanska, K., & Wright, S. (2017) What do national flags stand for? An exploration of associations across 11 countries. *Journal of Cross-Cultural Psychology*, 48, 335-352.
14. Roy, D., & Pammi, V. S. C. (2016). Promises and pitfalls of relating alteration of white matter pathways causing improvement in Cognitive performance. *Cognitive Neuroscience*, 8(2), 120-122.
15. Maqbool, Z., Makhijani, N., Pammi, V.S.C., & Dutt, V. (2017). Effects of motivation: rewarding hackers for undetected attacks cause analysts to perform poorly. *Human Factors*, 59(3), 420-431.
16. Pammi, V. S. C., Ruiz, S., Lee, S., Noussair, C., Sitaram, R. (2017). The effect of wealth shocks on loss aversion: behavior and neural correlates. *Frontiers in Neuroscience* (Section: Decision Neuroscience), 11:237.
17. Kar, B. R. & Kenderla, P. K. (2017). Working Memory and Executive Attention: Insights from Developmental Studies and Implications for Learning and Education. *Journal of the Indian Institute of Science*, 97, 497-510.
18. Srinivasan, N. (2017). Statistical summary perception in vision. *Journal of the Indian Institute of Science*, 97, 435-442.
19. Mishra, M. V., & Srinivasan, N. (2017). Exogenous attention intensifies perceived emotion expressions. *Neuroscience of Consciousness*, 3(1):nix022.
20. Mishra, M.V., Ray, S. B. & Srinivasan, N. (2018). Cross-cultural emotion recognition and evaluation of Radboud faces database with an Indian sample. *PloS one*, 13(10).

### Book Chapter and Conference Proceedings

1. Pasala, S., Khamassi, M., and Pammi, V.S.C (2018). Geometric features that describe reference frames in the intuitive landmarks during spatial navigation. *Proceedings of the Seventh International Conference on Spatial Cognition* (ICSC 2018). Rome, Italy.
2. Srinivasan, N. (in press). Cognitive science: Conceptual advances and status of research in India. In G. Misra (Ed.) *Sixth ICSSR Survey of Psychology*.
3. Srinivasan, N. (in press). Learner as a developing individual. NCERT Textbook for B.Ed. Students. New Delhi: NCERT.
4. Mishra, M. V., Ray, S. B., & Srinivasan, N. (2017). Effect of emotions on temporal attention. *Progress in Brain Research*, 236, 287-309.

### Fellowship and Travel Grants

1. 2017: Dr. Sujith Thomas was awarded postdoctoral fellowship under the Cognitive Science Research Initiative by the Department of Science and Technology, Gov. of India. The grant is for a period of two years (2017–2019).
2. 2017: Mukesh Makwana a graduate student at CBCS, received a travel grant to present his work on Intention and Prediction in Time Perception at the First Conference of the Timing Research Forum, Strasbourg, France.
3. June 2017: Amrendra Singh a Post-Doctoral fellow at CBCS, was awarded a grant to attend Summer Institute of the Mind-Life Institute held at New York, USA.
4. November 2018: Amrendra Singh a Post-Doctoral fellow at CBCS, received a scholarship from Mind and Life Institute, USA, to present his work at the International Symposium for Contemplative Research to be held in Phoenix, Arizona, USA in November 2018.
5. May 2018: Paridhi Mathur received a travel grant to attend IBRO-APRC Associate School on Electrophysiological enlightenment of System Neuroscience, Kathmandu, Nepal.

## In Conversation

CBCS is soon going to have the addition of two new lab facilities — a primate lab and a fMRI lab. These are valuable additions, and will open up new avenues for research in cognitive sciences at the centre. Recently, we had the privilege of knowing the views of two prominent scientists, Prof. Aditya Murthy and Dr. Sridharan Devarajan, on primate research and imaging studies respectively. They were very kind to take time off their busy schedules, and share their outlook on the research areas. We are thankful to them.



### **Prof. Aditya Murthy**

Chairperson, Center for Neuroscience,  
Indian Institute of Science, Bangalore.

Research Area: Brain mechanisms of motor control

**Q1.** Is Non-Human Primate (NHP) model indeed necessary for understanding of neuroscience of behavior? If yes, why?

The primate brain is uniquely characterized by a vast expansion of the prefrontal cortex, making the non-human primate possibly the closest realistic model system to study the cognitive aspects of behavior. The study of such behavior is essential if we are to eventually understand and treat disorders of cognition in humans such as Alzheimer's disease, depression, schizophrenia etc.

**Q2.** How NHP research has contributed towards human welfare?

Current treatments of Parkinson's disease and many related motor disorders that are refractory to drug treatment are now being treated by means of deep brain stimulation (DBS). This therapy was originally motivated by primate research to understand basal ganglia function. The value of DBS is now being evaluated for treatment of other ailments such as depression and Alzheimer's disease. Research in the area of brain machine interfaces to help humans with spinal cord injuries has also progressed largely due to non-human primate research that aims to decode intentions from neural recordings and relay them to muscles or artificial actuators to bypass the spinal cord.

**Q3.** What motivated you to take-up NHP research?

The intellectual question that fascinated me was to understand how computations that enable behaviors are instantiated in neural circuits. I wanted, and still wish, to understand this relation between mind and brain in behaviors that involve decision making and motor control.

**Q4.** What are the challenges you face in conducting NHP research and what keeps you going?

Conducting these experiments are time consuming. They also require mastery over multiple different areas of fields that in some sense can be quite disparate. For example, to perform successful experiments requires not only knowledge of psychology and neurophysiology, but also understanding of basic physiology and performing sterile surgeries as well as extensive use of computer programming, and some working knowledge of electronics. Moreover, these experiments require going beyond the confines of what is strictly defined as one's laboratory, since the success of the experiments require attention to details regarding animal husbandry to ensure the well-being of the animals. The value of the experiments, and the appreciation of their relevance to understand

the disease biology of motor disorders, which is also the subject of my research, is what keeps me motivated.

**Q5.** What steps should be taken to spread awareness regarding benefits from animal research?

I think it is important to highlight the success stories of animal research and be willing to engage with society and policy makers more effectively and transparently. We should also be able to inculcate in the younger generation a passion for research in biology highlighting the role of animal work in the same.



### **Dr. Sridharan Devarajan**

Assistant Professor,  
Welcome Trust DBT Intermediate Fellow,  
Indian Institute of Science, Bangalore.  
Research Areas: Cognition, Computation and  
Behaviour

*(Interviewed by Mahek Kirpalani, a second year master student at CBCS)*

**Q1.** Sir, could you please give us some insight about the kind of work happening in your lab?

Our work is primarily measuring mechanisms of attention and we use a variety of different techniques to get at this but we work with human models and some of the examples of techniques we use are functional MRI, EEG, TMS, Transcranial alternating stimulation, and visual psychophysics.

**Q2.** Could you please elaborate how functional MRI is useful in the work you are focusing on?

The functional MRI work that we do falls into two categories: the first is really about understanding mechanisms of attention and the brain. There is a sort of emerging evidence that there are two components to attention — one is the sensory enhancement component and the other is the decisional biasing component. We want to look at the neural correlates of these components. We use various kinds of connectivity measures and activity measures, and try to see which parts of the brain are correlated with each component of attention. The second component has to do with investigating the neural basis of Alzheimer's disease. In our ongoing project at the Centre for Neuroscience, we are trying to address this question, 'Can we predict certain kinds of cognitive impairment or dementia-like symptoms from the functional MRI scans, before the behavioural deficits onset?'

**Q3.** As compared to the pre-existing tools, what kind of advantages do you think fMRI poses over the other tools?

In terms of other techniques like EEG, functional MRI has a huge advantage over other techniques in its ability to map brain activity with reasonably good spatial resolution that techniques like EEG lack. Now, the other advantage with functional MRI is that you can measure subcortical regions, which are also very difficult to measure with EEG. There are certain regions like the basal ganglia, superior colliculus, which are buried deep inside the brain. With functional MRI, you can get deeper insights about the neural activities (though at slower time scales) of the subcortical regions, including a couple of regions that I'm very much interested in; namely, the superior colliculus and the thalamus.

**Q5.** Fortunately, the field of neuroimaging has grown in India. What are your views on the current scenario?

On neuroimaging in India, I think there's a lot of promise for that. I think there are truly few research scanners at research institutes, but that number is slowly increasing. IISC is also getting a scanner, so in the next few years we'll be able to make much greater strides in terms of neuroimaging research. Currently, we collaborate with hospitals in order to conduct fMRI research. They have their own limitations, in terms of priorities with scanning of patient populations and handling emergency cases, which makes it practically difficult to always have scan time freely available for our experiments. Hopefully the availability of these new research scanners in India will make it much easier to do sophisticated experiments. One of the other things that we see with neuroimaging dedicated research-only scanners, is that we can do combined protocols like combined EEG-fMRI or combined TMS-fMRI.

**Q6.** For big projects like the connectome project, fMRI was extensively used. So, in the years to come, do you think we'd be able to perform similar projects and uncover similar insights in our country?

I think there's definitely potential. So, the connectome project is a very ambitious project and one of the reasons why it succeeded is because of a unique sort of insight that drives the project, the idea here being that fMRI studies with very small sample sizes do not have sufficient statistical power to make the claims that they need to make and unfortunately, the result of this has been that the findings of many studies have been difficult to replicate. This is not entirely the fault of scientists; obviously, there is need for more rigour and things like this, but the reality is that fMRI has very poor signal to noise, which means that to see results very reliably across participants, you need large cohorts of subjects. And that's where studies like the human connectome project have provided a very interesting and thoughtful solution by scanning many hundreds — and now it has passed thousand subjects — whose fMRI scans, diffusion MRI scans are freely available online. India could sort of help with this by, for example, developing a country (India)-specific brain template or looking to see if there are differences between the predominantly Caucasian or western population and Indian people and southeast Asian population in terms of brain measures, structure and function.

**Q7.** What are the issues you face on an everyday basis while conducting your own imaging research?

One general issue with imaging research is that functional MRI data is not directly a reflection of neural activity. In order to map it directly to neural activity, one has to make certain assumptions. But I think at the same time, perhaps fMRI researchers should look at the fMRI signal as sort of its own thing having independent validity regardless of what the underlying neural activity is doing and once it is clear that there are correlations between functional MRI activity and behaviour, then for example, if one can show that activity in a particular region can predict behaviour, I see no need to map back to neural activity to justify why fMRI is useful as a technique in terms of understanding the brain. I think it has an independent validity of its own, and I think the field is slowly recognising that but there should be more recognition of that idea.

*(The above conversation is a verbatim report created from an audio recording of the interview.)*

## The Editorial Board



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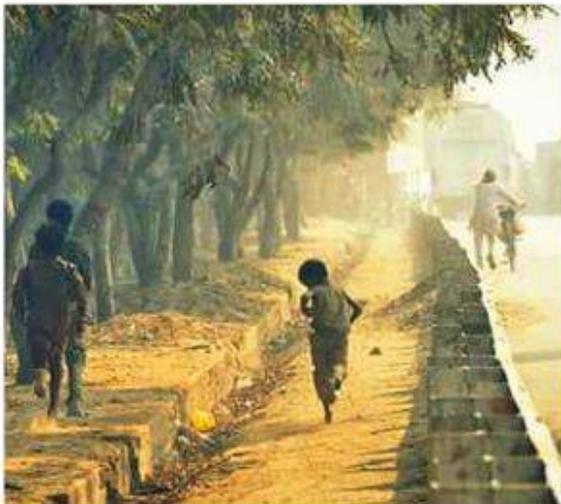
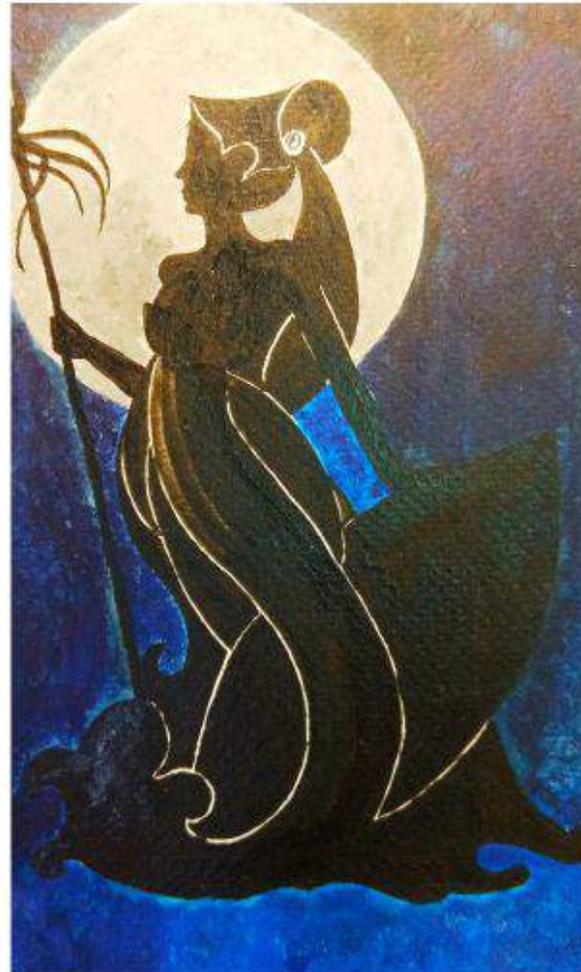


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