INSA-Leopoldina Symposium
"The Challenge to Learn: New Approaches to Study the Problem of Stability vs. Plasticity in the Brain"

Joint Academies' Symposium of the Indian National Science Academy (INSA) and the German National Academy of Sciences Leopoldina

28–29 November 2017

L V Prasad Eye Institute | Hyderabad | India

Impressum

Cover Image
Quelle: pixabay.com

Content & Editing
German National Academy of Sciences Leopoldina
International Relations Department

Design
unicom Werbeagentur GmbH | Berlin | Germany

Printed in India

Content

INSA-Leopoldina Symposium "The Challenge to Learn: New Approaches to Study the Problem of Stability vs. Plasticity in the Brain"

Joint Academies' Symposium of the Indian National Science Academy (INSA) and the German National Academy of Sciences Leopoldina

28–29 November 2017
L V Prasad Eye Institute | Hyderabad | India

Learning and adaptation, the organism's ability of flexibly reacting and adjusting to its environment is central for brain functioning and behaviour. As such, learning has been broadly investigated under different labels in virtually all areas of neuroscience and cognitive science. Different approaches have been used; in particular, computational neuroscience has addressed the computational bases of learning, while neuroscientific research in animals, including humans, has explored the implementation of these computational principles in the nervous system. The essential challenge the brain faces is to allow for plasticity while keeping a certain level of stability. How to act reliably in a complex environment, while acknowledging and handling the fact that the environment itself will change over time?

On the neural level, internal representations are acquired, to a large extent, under the influence of experience. In addition, representations emerging earlier comprise building blocks for subsequently acquired knowledge. Thus, it is crucial to retain previously attained representations when new knowledge is added. At the same time, the brain needs to be able to quickly adapt to new requirements at all times. Hence, it needs to continuously maintain a balance between plasticity and stability. Behaviourally, this balancing act typically leads to highly efficient and adaptive performance.

Computationally, the stability-plasticity issue maps to the classic bias-variance problem of decision-making and machine learning: the more knowledge is accumulated from past experience, the more difficult it is to efficiently integrate a small bit of new evidence. While the bias-variance problem is non-reconcilable, optimal compromises under particular circumstances can be identified. Recent effort has developed methods to identify such optimal solutions.

The present symposium will concentrate on the latest developments on the issue of stability vs. plasticity on both computational and neural levels. Presentations will focus on demonstrating how the nervous system maintains the stability-plasticity balance across different time scales, e.g. during performing a unimodal or crossmodal task or while acquiring knowledge such as object representations across the life span, as well as in response to injury such a sensory deprivation or disease. While presentations from neuroscience will introduce recent findings of how learning is implemented in the nervous system, computationally oriented presentations will discuss contemporary advances in traditional, dynamical and probabilistic frameworks for understanding the rationale why these neural mechanisms are efficient for keeping the stability-plasticity balance in the brain and thus for guaranteeing adaptive behaviour.

In 2007, the Indian National Science Academy (INSA) and the German National Academy of Sciences Leopoldina signed a Memorandum of Understanding, which was renewed in 2012, to highlight their strategic partnership. Within the framework of this cooperation agreement, high-profile joint symposia on topics of global relevance are organised on a regular basis.

The symposium in 2017 is organised under the joint leadership of INSA and Leopoldina member Professor Dr Dorairajan Balasubramanian (L V Prasad Eye Institute) and Leopoldina member Professor Dr Brigitte Roeder (Institute for Psychology of the University of Hamburg). The symposium's organising committee consists of Professor Dr József Fiser (Central European University, Department of Cognitive Science), Professor Dr Brigitte Roeder (University of Hamburg, Institute for Psychology), Professor Dr Dorairajan Balasubramanian (L V Prasad Eye Institute) and Professor Dr Neeraj Jain (National Brain Research Centre).

Programme

Tuesday, 28 November 2017

09.00 – 09.15 | Welcome Addresses

Dorairajan Balasubramanian, *Member of INSA and of the Organising Committee, Director of Research Emeritus, L V Prasad Eye Institute*

Frank Roesler, *Member of the Leopoldina Presidium*
N. R. Jagannathan, *Vice President, Indian National Science Academy*

09.15 – 10.00

The Emergence of Distributed Functional Networks in the Early Developing Cortex
Matthias Kaschube

10.00 – 10.45

Cracking the Code for Visual Objects
Sripati Panditaradhyula Arun

10.45 – 11.30

The Case for Probabilistic Learning to Handle the Stability/Plasticity Problem
József Fiser

11.30 – 12.00 | Coffee Break

12.00 – 12.45

Fast Acting Antidepressants – Reopening Critical-Period Like Plasticity?

Vidita Vaidya

12.45 – 13.30

Systems Consolidation of Memory During Sleep
Jan Born

13.30 – 14.15 | Lunch Break

14.15 – 15.00

Transformation of the Reorganized Inputs as They Ascend from the Brain Stem Nuclei to the Cortex Following Partial Spinal Cord Injuries
Neeraj Jain

15.00 – 15.45

Spatial Scales of Plasticity in the Visual Cortex
Tara Keck

15.45 – 16.15 | Tea, Coffee Break

16.15 – 17.00

Computing with a Self-Modifying Machine: Multiple Scales of Plasticity at the Synapse
Upinder Bhalla

17.00 – 17.45

Can the Visual System Learn to Handle Inter-Ocular Differences in Space and Time?
Shrikant Bharadwaj

17.45 – 19.30 | Tour LVPEI

19.30 | Dinner (Invitees Only)

Wednesday, 29 November 2017

09.00 – 09.45

Internal Models: Of Ferret and Man
Máté Lengyel

09.45 – 10.30

Multi-Scale Representational Space of Cross-Modal Perception
Arpan Banerjee

10.30 – 11.15

The Challenge to Learn in Development vs. Adulthood
Brigitte Roeder

11.15 – 11.45 | Coffee Break

11.45 – 13.00 | Poster Presentations

Junior Scientists (cf. Abstracts p. 29–46)

13.00 – 13.45 | Lunch Break

13.45 – 14.30

Neural Circuits, Singing and Song Learning in Zebra Finches
Soumya Iyengar

14.30 – 15.15

The Adaptive Brain in Action: Cellular Correlates of Learning, Memory and Forgetting
Martin Korte

15.15 – 15.45 | Tea, Coffee Break

15.45 – 16.30

Neural Control of Sequential Movements
Aditya Murthy

16.30 – 17.15

Stability Through Plasticity in the Active Visual System
Martin Rolfs

17.15 – 18.15 | Wrapping Up and Transition to Evening Event

18.15 – 19.30

Eliciting Topics from Large Corpora – a Brief History
Chiranjib Bhattacharya

20.00 | Dinner (Invitees Only)

List of Participants

Sripati Panditaradhyula Arun	Indian Institute of Science, Bangalore, India
Dorairajan Balasubramanian	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Arpan Banerjee	National Brain Research Centre, Manesar, India
Upinder S. Bhalla	National Centre for Biological Sciences, Bangalore, India
Shrikant R. Bharadwaj	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Chiranjib Bhattacharya	Indian Institute of Science, Bangalore, India
Jan Born	University of Tuebingen, Tuebingen, Germany
Vijay Reena Durai	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Kurni Eswar	L V Prasad Eye Institute (LVPEI), Hyderabad, India
József Fiser	Central European University, Budapest, Hungary
Shonraj Ballae Ganeshrao	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Maria J. S. Guerreiro	University of Hamburg, Hamburg, Germany
Bettina Hein	Frankfurt Institute for Advanced Studies (FIAS), Frankfurt (Main), Germany
Soumya Iyengar	National Brain Research Centre, Manesar, India
N. R. Jagannathan	Vice President, Indian National Science Academy, New Delhi, India
Neeraj Jain	National Brain Research Centre, Manesar, India
Matthias Kaschube	Johann Wolfgang Goethe University, Frankfurt (Main), Germany
Tara Keck Lesica	University College London, London, UK
Ádám Koblinger	Central European University, Budapest, Hungary
Marina Koch-Krumrei	German National Academy of Sciences Leopoldina, Halle (Saale), Germany
Martin Korte	Technische Universitaet Braunschweig, Braunschweig, Germany
G. Vinodh Kumar	National Brain Research Centre, Manesar, India
Praveen Kumar Bandela	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Clara Kuper	Humboldt University of Berlin, Berlin, Germany
Máté Lengyel	University of Cambridge, Cambridge, UK
Aditya Murthy	Indian Institute of Science, Bangalore, India
Ruth Narmann	German National Academy of Sciences Leopoldina, Halle (Saale), Germany
José Ossandón	University of Hamburg, Hamburg, Germany
Kabilan Pitchaimuthu	University of Hamburg, Hamburg, Germany

Brigitte Roeder	University of Hamburg, Hamburg, Germany
Frank Roesler	German National Academy of Sciences Leopoldina, Halle (Saale), Germany
Martin Rolfs	Humboldt University of Berlin, Berlin, Germany
Suddha Sourav	University of Hamburg, Hamburg, Germany
Rebecca Sumalini	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Vidita Vaidya	Tata Institute of Fundamental Research, Mumbai, India
Pavan K. Verkicharla	L V Prasad Eye Institute (LVPEI), Hyderabad, India
Paul Zerr	University of Hamburg, Hamburg, Germany
Katharina Zinke	University of Tuebingen, Tuebingen, Germany

Abstracts of Presentations

(in order of programme)

Matthias Kaschube

Frankfurt Institute for Advanced Studies
Ruth-Moufang-Str. 1, 60438 Frankfurt am Main
Germany

kaschube@fias.uni-frankfurt.de
https://www.fias.uni-frankfurt.de/de/neuro/kaschube/

The Emergence of Distributed Functional Networks in the Early Developing Cortex

The cortical networks that underlie behaviour exhibit an orderly functional organisation at local and global scales. In the visual cortex of carnivores and primates, neighbouring columns of neurons represent the full range of stimulus orientations and contribute to distributed networks spanning several millimetres. However, the principles governing functional interactions that bridge this fine-scale functional architecture and distant network elements remain unclear; and, the emergence of these network interactions during development remains unexplored. Here, I talk about joint work with the laboratory of David Fitzpatrick where we used calcium imaging of spontaneous activity patterns in mature ferret visual cortex to reveal remarkably widespread and specific modular correlation patterns such that the local fine-scale structure of visually-evoked orientation columns is accurately predicted by the spontaneous activity of neurons that lie several millimetres away. The large-scale networks revealed by correlated spontaneous activity show abrupt 'fractures' in continuity that are in tight register with evoked orientation pinwheels. Chronic in vivo imaging demonstrates that these large-scale modular correlation patterns and fractures are both present and predictive of the mature network structure at early stages of cortical development, prior to the elaboration of long-range horizontal network connections. A circuit model limited to local connections that constrains the dimensionality of activity patterns in agreement with our empirical data, accounts quantitatively for the observed spatial extent of correlations and the strength of fractures in the early cortex. These results demonstrate the precise local and global organisation of cortical networks revealed through correlated spontaneous activity and suggest that local connections in early cortical circuits generate structured long-range network correlations that underlie the subsequent formation of visually-evoked distributed functional networks.

Sripati Panditaradhyula Arun

Centre for Neuroscience, Indian Institute of Science
Bangalore 560012
India

sparun@cns.iisc.ernet.in
https://www.sites.google.com/site/visionlabiisc/

Cracking the Code for Visual Objects

Vision is deceptively easy but in fact it is an extremely challenging computational problem for computers. How does the brain solve vision? How can we crack the code used by the brain to represent visual objects? I will present recent findings from our lab elucidating the code for visual objects using both behavioural experiments in humans and single neuron recordings from monkeys. This code operates according to systematic rules, incorporates knowledge about the world, enables simple decoding of relevant information and is systematically different from most computer vision algorithms.

József Fiser

Department of Cognitive Science, Central European University
Október 6 utca 7, 1051 Budapest
Hungary

fiserj@ceu.edu
http://www.visionlab-ceu.org

The Case for Probabilistic Learning to Handle the Stability/Plasticity Problem

Visual perception and visual learning are usually investigated separately and in the classical framework defined by the seminal work of Hubel and Wiesel over half a century ago. In this view, perception is an essentially feed-forward pipelining of signal detection steps, while learning is a gradual accumulative process, by which tallies of past events are gathered. Through case studies, I will argue three points that fundamentally challenge this view. First, complexity of the task at hand during perception and learning requires a probabilistic representation and computation by the brain rather than a simple signal processing and data accumulation. A probabilistic approach, in turn, requires that perception and learning be handled jointly. Second, such approach can capture human behaviour more precisely than alternative accounts in tasks such as visual statistical learning and cue combination. Third, looking at sequential processes, the slow accumulation hypothesis of the classical approaches cannot explain recent human results, whereas a more sampling-driven probabilistic account can. Together, these results point to a general probabilistic framework of perception and learning that can naturally handle the long-standing computational issues of the stability/plasticity problem.

Vidita Vaidya

Tata Institute of Fundamental Research
1, Homi Bhabha Road, Colaba, Mumbai 400005
India

vvaidya@tfr.res.in
http://www.tifr.res.in/~dbs/faculty/vvlab/Research.html

Fast Acting Antidepressants – Reopening Critical-Period Like Plasticity?

Depression is thought to involve an inability to mount adaptive structural changes in key neuronal networks. Animal models of depression exhibit dendritic atrophy, altered glial numbers, a decline in hippocampal neurogenesis and also show reduced trophic and angiogenic factor expression. In contrast, chronic antidepressant treatments promote structural plasticity, increase adult hippocampal neurogenesis and enhance trophic and angiogenic factor expression, changes required for specific behavioural effects of antidepressants. However, these adaptive changes arise only in response to sustained antidepressant administration and are slow in their onset, which is thought to contribute to the delay in the therapeutic effects of existing antidepressants. In my talk, I will discuss our results on how adjunct treatments to classical antidepressants, as well as fast-acting antidepressants such as electroconvulsive seizure therapy, work to accelerate effects of behaviour, as well as structural plasticity within key limbic regions such as the hippocampus. Further, I will discuss the idea that fast-acting antidepressant treatments may serve to recruit developmental signalling morphogens to bring about rapid effects on structural plasticity and neurogenesis, as well as contributing to dissolution of extracellular matrix associated perineuronal nets which could promote local synaptic plasticity.

Jan Born

Institute for Medical Psychology and Behavioural Neurobiology, University of Tuebingen
Otfried-Müller-Str. 25, 72076 Tuebingen
Germany

jan.born@uni-tuebingen.de
http://www.medizin.uni-tuebingen.de/en/patients/institutes/medical+psychology.html

Systems Consolidation of Memory During Sleep

Whereas memories are encoded and retrieved optimally when the brain is awake, the consolidation of memory requires an offline mode of processing as established optimally only during sleep. Recent studies have elucidated some of the neurophysiological mechanisms underlying memory consolidation during sleep, especially in the hippocampus-dependent declarative memory system. This system is capable of rapidly forming an initial memory representation for an episode upon its one-time occurrence, and is thus at the basis of the formation of any long-term memory. Consolidation of hippocampus-dependent memories represents an active systems consolidation process that takes place mainly during slow wave sleep (SWS) rather than REM sleep. It critically relies on the neural reactivation of newly encoded memory representations which originates from hippocampal circuitry and stimulates the gradual redistribution of the representations towards extra-hippocampal, mainly neocortical networks serving as long-term store. The redistribution process goes along with a qualitative transformation of the representation ending up in the formation and storage of abstracted schema-like memories stored in the neocortex. Memory reactivations originating from the hippocampus are synchronised to the <1Hz EEG slow oscillations that dominate SWS and are generated in neocortical networks, partly as a function of the prior use of these networks for encoding of information. By synchronising hippocampal memory reactivations with specific activity from other brain areas, including thalamo-cortical spindles, slow oscillations enable persisting plastic changes underlying the long-term storage of memories in the neocortex.

Neeraj Jain

National Brain Research Centre
N.H. 8, Manesar (Haryana) 122051
India

neeraj.jain@nbrc.ac.in; njain.nbrc@gmail.com
http://www.neerajlab.weebly.com/

Transformation of the Reorganized Inputs as they Ascend from the Brain Stem Nuclei to the Cortex Following Partial Spinal Cord Injuries

Deafferentation due to spinal cord injuries in adult primates leads to plasticity at multiple levels along the somatosensory neuraxis. Such injuries result in intact face inputs expanding into the deafferented regions of the cuneate nucleus of the brain stem, ventroposterior lateral nucleus (VPL) of the thalamus, and primary and secondary somatosensory areas of the cortex. These plastic changes are mediated by key changes in the brain stem nuclei. Expansion of the face representation into the cuneate nucleus, which is due to sprouting from the adjacent spinal trigeminal nucleus, cascades upstream and is expressed as plasticity in the hand region of the primary somatosensory cortex (area 3b). Interestingly, in the cuneate nucleus and VPL, the intact arm and occiput/neck/shoulder inputs also expand in the deafferented hand region, which is not seen in area 3b. Selective expression of these representations is likely regulated in VPL as the thalamocortical inputs ascend to area 3b.

Tara Keck

Department of Neuroscience, Physiology and Pharmacology
University College London
21 University Street, London WC1E 6DE
United Kingdom

http://www.kecklab.com

Spatial Scales of Plasticity in the Visual Cortex

Homeostatic synaptic scaling is thought to occur cell-wide, but recent evidence suggests this form of stabilising plasticity can be implemented more locally in reduced preparations. To investigate the spatial scales of plasticity in vivo, we used repeated two-photon imaging in mouse visual cortex after sensory deprivation to measure TNF-α dependent increases in spine size as a proxy for synaptic scaling in vivo in both excitatory and inhibitory neurons. We found that after sensory deprivation, increases in spine size are restricted to a subset of dendritic branches, which we confirmed using immunohistochemistry. We found that the dendritic branches that had individual spines that increased in size following deprivation also underwent a decrease in spine density. Within a given dendritic branch, the degree of spine size increases is proportional to recent spine loss within that branch. Using computational simulations, we show that this compartmentalized form of synaptic scaling better retained the previously established input-output relationship in the cell, while restoring activity levels.

Upinder S. Bhalla

National Centre for Biological Sciences, TIFR
Bangalore 560065
India

bhalla@ncbs.res.in
https://www.ncbs.res.in/faculty/bhalla

Computing with a Self-Modifying Machine: Multiple Scales of Plasticity at the Synapse

When we learn, many microscopic changes occur in the activity and chemical signalling at synapses between neurons in the brain. In addition, the synapses can themselves grow and retract. This is a remarkable capability because it means that the machinery of neural computation can, as a result of its computations, modify its own wiring. Such self-modifying machines are notoriously difficult to understand in engineering terms, yet it is a basic part of how the brain computes. We have investigated how such self-modification can be controlled by neuronal signalling, and also what implications it may have for neuronal activity. We carry out abstract as well as detailed simulations of these processes as synaptic input impinges on a set of synapses on which we implement multiscale learning rules. Through these, we explore the interplay between electrical and chemical signalling, which in turn modify the structure and activity of synapses. We examine configurations that may achieve long-term stability of connections while retaining plasticity for new memories.

Shrikant R. Bharadwaj

Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Road 2 Banjara Hills, Hyderabad
India

bharadwaj@lvpei.org
http://www.lvpei.org/our-team/our-team-sbharadwaj.php

Can the Visual System Learn to Handle Inter-Ocular Differences in Space and Time?

We have two eyes for a reason – our ability to perceive 3D and compute distance and direction is highly enhanced with the two eyes working together as a team. Such an ability is highly dependent on the similarity of inputs to both eyes. There are instances – physiological, pathological and iatrogenic – when such a similarity in visual inputs is disrupted in space and time. Spatially, one eye may see this world more distorted than the other eye and, in time, one eye may see things with a slight delay relative to the other eye. What are the consequences of such inter-ocular differences in spatial and temporal input? What happens when such differences become part of one's natural viewing? What mechanism does the visual system adopt to handle such inter-ocular differences and what implications do these have when treating patients in the clinic? These questions will be discussed in my talk with evidence for some adaptive behaviour by the visual system to handle such inter-ocular differences in visual input.

Máté Lengyel

Department of Engineering, University of Cambridge
Trumpington Street, Cambridge CB2 1PZ
United Kingdom

m.lengyel@eng.cam.ac.uk
http://www.eng.cam.ac.uk/~m.lengyel

Internal Models: Of Ferret and Man

Our percepts rely on an internal model of the environment, relating physical processes of the world to inputs received by our senses, and thus their veracity critically hinges upon how well this internal model is adapted to the statistical properties of the environment. We used a combination of Bayesian inference-based theory and novel data analysis techniques applied to a range of human behavioural experiments, as well as ferret electrophysiological recordings, to reveal the principles by which complex internal models (1) are represented in neural activities, (2) are adapted to the environment, (3) can be shown to be task-independent, and (4) generalise across very different response modalities.

Arpan Banerjee

National Brain Research Centre
NH8 Manesar, Gurgaon - 122051
India

arpan@nbrc.ac.in, arpan.nbrc@gov.in
http://www.cognitivebrainlab.weebly.com/

Multi-Scale Representational Space of Cross-Modal Perception

Multisensory integration has excited a large group of researchers from psychologists, computer scientists, neurophysiologists and finally the neuroimaging community and triggered a wide body of research. Yet, the representational space of multisensory processing such as cross-modal perception observed during McGurk-stimuli processing remains elusive. In this talk, I would like to delimit the boundaries of these representational spaces using the results obtained from multimodal neuroimaging techniques EEG and fMRI. Finally, I will present a computational model inspired by neurobiologically realistic parameters that attempts to link the behavioural results with patterns of activity observed in neuroimaging recordings. The overarching goal of the talk is to build a mechanistic understanding of the neural dynamics observed at individual brain regions and across a functional network comprised of multiple brain areas.

Brigitte Roeder
Biological Psychology and Neuropsychology, University of Hamburg
Von Melle Park 11, 20146 Hamburg
Germany

brigitte.roeder@uni-hamburg.de
http://www.bpn.uni-hamburg.de

The Challenge to Learn in Development vs. Adulthood

Learning at the beginning of the ontogenetic development cannot be guided by internal models of the world and thus needs to involve mechanisms which are to a larger degree bottom-up driven by sensory input. Later learning, in contrast, should make use of models of the world which were acquired and shaped by experience. Indeed, infants seem to quickly learn cross-modal statistics in passive exposure settings. By contrast, adults seem to learn them only if they are task relevant. Developmental learning in some domains is linked to sensitive phases, resulting in incomplete learning in this domain in adulthood. Here we demonstrate in humans that what was learned within the sensitive period is at least partially conserved. However, this does not necessarily seem to interfere with later learning in cases when the environment dramatically changes. For example, restoring vision after a congenital blindness is not followed by a complete loss of crossmodal compensation in auditory motion processing and related neural mechanisms although visual motion processing is acquired at least to some degree.

Soumya Iyengar

National Brain Research Centre, Manesar
NH-8, Nainwal Mode, Gurugram, Haryana -122051
India

soumya@nbrc.ac.in
http://www.nbrc.ac.in

Neural Circuits, Singing and Song Learning in Zebra Finches

Zebra finches are excellent models for studying vocal learning since they learn their songs from their fathers during a sensitive period, much as humans learn speech. During development, songs are memorised and practised until male zebra finches produce almost perfect copies of their father's songs at adulthood. Singing, song learning, perception and hearing are controlled by different sets of neural circuits in songbirds, whose organisation is similar to those important for human speech and hearing. We had earlier shown that song-control regions in adult male zebra finches express both μ- and δ-opioid receptors (ORs), which are components of the endogenous opioid system. Further, we found that the opioid system modulated singing and the motivation to sing in adult male zebra finches. Blocking the endogenous δ-OR system using specific antagonists for short intervals of time during the sensitive period led to long-term changes in vocalisation. Whereas the motivation to sing to females was not altered when these birds reached adulthood, their songs became less complex, with significant changes in various acoustic properties. We also found that blocking δ-ORs led to an increase in the production or survival of medium spiny neurons in a part of the avian basal ganglia involved in singing. Our results suggest that δ-OR neuromodulation during the sensitive period for song learning can have long-term effects on singing, since it alters the neural circuits underlying this behaviour. Given the similarities between neural circuits involved in song control and speech, our results suggest that opioid neuromodulation may be important for vocal learning across different species.

Martin Korte

Zoological Institute, Div. Cellular Neurobiology , TU Braunschweig
Spielmannstr. 7, 38106 Braunschweig
Germany

mkorte@tu-bs.de
http://www.zoologie.tu-bs.de/

The Adaptive Brain in Action: Cellular Correlates of Learning, Memory and Forgetting

Changes in the connectivity of neurons – activity dependent synaptic plasticity – regulate the fine-tuning of neuronal networks during development and adult learning. Synaptic plasticity includes functional and structural modifications at neurons. Both changes occur in a 'positive' (synapse strengthening, dendritic spine growth) and in a 'negative' (synapse weakening, dendritic spine loss) way. On the other hand, in vivo imaging studies demonstrate that the large-scale organisation of axons and dendrites as well as the majority of synaptic structures in several areas of the mature, intact brain shows a remarkable stability. These observations implicate the existence of a set of molecules regulating the stability of mature neuronal networks at the end of development. Dendritic spine number and dendritic arbor complexity can change during activity-dependent plastic processes. The underlying mechanisms and molecules are largely unknown. Neurotrophins modulate neuronal morphology and support functional changes at synapses. So far, mainly the role of BDNF and its TrkB receptor has been studied by us and others in order to elucidate processes of positive synaptic plasticity, synaptic scaling and synaptic tagging. In addition, we are interested in the process of negative synaptic plasticity (weakening of synapses and loss of synaptic structures) and we study mechanisms and molecules that mediate stability of neuronal networks. In search for factors restricting functional as well as structural plasticity processes, we investigated the role of the myelin-associated protein Nogo-A, whose function as negative regulator of structural changes in the CNS is well known.

Aditya Murthy

Centre for Neuroscience, Indian Institute of Science
Bangalore, 560012
India

http://www.cns.iisc.ernet.in/aditya/

Neural Control of Sequential Movements

Natural behaviour entails making multiple movements in a sequence to achieve day-to-day tasks. Natural vision, too, involves making sequential eye movements to points of interest in the visual scene. Using fast eye movements, called saccades, as a model, I will try to elucidate some important aspects underlying the sequential processing of movements. I will present the results obtained from neural recordings from the macaque frontal eye field (FEF), a brain area critical for saccade planning and generation. First, we tested whether in a sequence of two saccades, the second saccade can be programmed in parallel with the first. Second, we will present results that characterise the limits of parallel programming and, in the process, show the neural basis of processing bottlenecks when two saccade plans overlap closely.

Martin Rolfs

Humboldt University of Berlin
Unter den Linden 6, 10099 Berlin
Germany

martin.rolfs@hu-berlin.de
http://www.rolfslab.de

Stability Through Plasticity in the Active Visual System

Saccadic eye movements shift our gaze direction about 10,000 times every waking hour, allowing us to see every aspect of a visual scene in great detail. Psychophysical studies suggest that vision undergoes turbulent changes every time the eyes make these rapid movements: we mislocalize flashed stimuli in space and time, our visual sensitivity is notably hampered across the visual field, and visual sensory memory is wiped out as the saccade imposes drastic displacements of the image on the retina. I will present research investigating how the active visual system bridges the abrupt discontinuities accompanying saccades to shape a seamless perceptual experience of the world. I will argue that learning, attention, and memory play key roles in this process. I will also discuss the function of re-afferent signals, which have long been neglected as a source of visual stability in the face of eye movements.

Chiranjib Bhattacharya

Indian Institute of Science
Bangalore 560012
India

chiru@iisc.ac.in
http://www.mllab.csa.iisc.ernet.in

Eliciting Topics from Large Corpora – a Brief History

Eliciting themes from large text corpora remains an important problem area with many applications. I will present an overview of the area and present a unified view of various models. Moreover, I will present recent results which show that under realistic assumptions, but significantly weaker than those prevalent in literature, an SVD based algorithm recovers true topic models. This result refutes a folklore that SVD based algorithms cannot recover topic models.

Abstracts of Poster Presentations

(in alphabetical order)

Vijay Reena Durai

Vision Psychophysics Laboratory, Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad
India

creena@lvpei.org

The Pulfrich Illusion: Minimum Interocular Luminance Difference Required to Experience a Pulfrich-Type Motion Depth Illusion

The Pulfrich effect is a motion-induced depth illusion wherein the subject perceives the leftward and rightward movement of an object in a perfectly horizontal plane to follow an elliptical path when there is a difference in the luminance input to the two eyes. The current research work focuses on neural adaptation to motion-related depth illusion in patients with interocular differences in image quality (e.g. unilateral cataract). Even while many characteristics of the Pulfrich phenomenon are known, the minimum interocular luminance difference required to reliably elicit this effect remains unknown. The purpose of the study was to determine the threshold interocular luminance difference that would reliably elicit a Pulfrich-type motion depth illusion in visually healthy adults.

We had recruited 11 subjects as a part of the pilot study. Interocular illuminance disparity was created using neutral density filters (0.1 to 1.0 log units) in one of the eyes. Each subject had undergone a total of 100 trials (10 trials/NDF). The threshold was calculated from the 50% correct response of a cumulative Gaussian fit to the psychometric function generated through a 2-alternate forced choice. Added along with this, the pupil size was also simultaneously measured. The pupil measurements give a wide knowledge about the binocular responses of pupils for a given interocular difference in light levels. As expected, there were variations noted in the pupil size with regard to the attenuation of light. On the other hand, magnitude of induced anisocoria calculated from the pupil size of the filtered and unfiltered eye was almost similar for all the subjects. Overall, we had the basic data for understanding the pupil variations for the aniso-illuminance state and the minimum level of attenuation of light that induce such type of motion illusion in normal subjects.

The broader spectrum of the study is to explore the subjects with unilateral cataract and the magnitude of illusion experienced by them. The outcome of the study will provide critical information on whether patients with unilateral cataract surgery experience any depth related abnormality in their routine life and if this illusion can be an objective deciding criterion for the cataract surgery in the fellow eye.

Kurni Eswar
Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad
India

Study of Reflexive Eye Movements as a Measure of Visual Function

K Eswar[1], Dr Premnandhini Satgunam[1 2],

1. Brien Holden Institute of Optometry and Vision Sciences, L V Prasad Eye Institute, Hyderabad, India.
2. Bausch & Lomb School of Optometry, L V Prasad Eye Institute, Hyderabad, India.

Learning through vision plays a huge role in the developmental milestones of children. Poor visual acuity delays the milestones in other sensory domains as well (e.g. grasping, crawling). Measuring visual acuity for children thus becomes important especially when there is visual impairment. Determining the acuity can give an estimate for what object sizes a child can see. However, measuring visual acuity in non-verbal children poses a challenge to the clinicians. It is even more challenging in cases of children having additional disabilities with delayed developmental milestones. There are few traditionally used acuity procedures to quantify grating acuity in non-verbal children. However, their measurement is limited to examiner judgement (e.g. teller acuity cards). Hence, in attempting to understand recognition acuity objectively, we investigated the potential of using reflexive eye movements. As a first step, we enrolled adult participants who were shown a target followed by a brief exposure to two targets, one of which was the previously exposed target. We hypothesized that reflexively the participant may first look at the familiar target. No instructions were given to the participant besides asking them to look at the monitor. We observed that majority of the participants reflexively looked towards the familiar target 55% of the time. Importantly, it also appears that stimuli exposure duration may have an influence, with a longer duration (600ms) eliciting reflexive eye movements towards a familiar target. Further studies are needed to understand the looking behaviour to the familiar target.

Shonraj Ballae Ganeshrao
VST Center for Glaucoma, Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad
India

shonraj@lvpei.org

Sampling the Visual Field Based on Individual Retinal Nerve Fiber Layer (RNFL) Thickness Profile

Current perimeters use fixed grid patterns to sample the visual field (VF). In this study, we developed a defect-based sampling method that samples the VF based on an individual's retinal nerve fiber layer (RNFL) thickness profile. To test this, we collected the baseline VF of 23 glaucoma subjects with high spatial resolution 2 X 2 degree grid (386 locations in total) using a suprathreshold procedure. Peripapillary RNFL thickness was measured using spectral domain optical coherence tomography. An individualised map was used to relate VF locations to optic disc locations. Defect-based sampling pre-selects half of the VF locations (n=26) from the 24-2 pattern, which were the 26 locations with the highest positive predictive value to detect glaucoma. The remaining 26 locations were positioned based on an individual's RNFL thickness. The outcome measure was a count of the abnormal locations discovered by the defect-based method and the 24-2 grid. The defect-based sampling method identified more abnormal locations on 2/3 of the patients, and was significantly better than the 24-2 grid sampling scheme (defect-based versus 24-2 $p<0.001$). Structural information can customise sampling of VF defects for individual patients, resulting in a higher probability of detecting areas of damage.

Maria J. S. Guerreiro
Biological Psychology and Neuropsychology, University of Hamburg
Von-Melle-Park 11, 20146 Hamburg
Germany

maria.guerreiro@uni-hamburg.de
http://www.bpn.uni-hamburg.de

Structural Brain Changes in Cataract-Reversal Individuals

Neuroimaging studies in permanently blind individuals have started to reveal the consequences of visual deprivation on brain structure. These studies have shown that congenital or early blindness is associated with atrophy in the anterior visual pathway (i.e. optic nerve, optic chiasm, and optic tract), as well as with increased cortical thickness in a number of occipital brain areas (e.g. calcarine sulcus, cuneus, lingual gyrus, lateral occipital cortex). In the present study, we investigated whether a brief period of congenital blindness due to dense bilateral cataracts induces similar structural brain changes, by assessing a group of cataract-reversal individuals and age-matched normally sighted controls who underwent magnetic resonance imaging. The results revealed that a brief period of congenital blindness is associated with structural brain changes similar to those observed in permanently blind individuals, such as increased cortical thickness in occipital brain areas. Furthermore, occipital cortical thickness in cataract-reversal individuals was negatively correlated with behavioural performance in an audio-visual task for which visual input was critical, suggesting that the higher the cortical thickness, the lower the behavioural performance. These results suggest that a brief period of congenital blindness leaves permanent traces in brain organisation, thus underscoring the critical role of early visual input on brain development.

Bettina Hein

Frankfurt Institute for Advanced Studies
Ruth-Moufang-Str 1, 60438 Frankfurt
Germany

hein@fias.uni-frankfurt.de
https://www.fias.uni-frankfurt.de/neuro/kaschube/

Highly Variable Evoked Network Responses in the Early Developing Ferret Visual Cortex

Selectivity for stimulus orientation is a fundamental property of primary visual cortex in primates and carnivores, where it is organised into a smoothly varying columnar map that emerges in an activity-dependent manner during early postnatal life. Despite extensive experimental and theoretical work, it remains unclear what factors limit the emergence of orientation selectivity, such as weak responsiveness to visual stimuli, high trial-to-trial variability, and/or an intermixed 'salt-and-pepper' organisation of orientation preferences at the cellular level. To distinguish between these potential factors, we visualised population activity in the visual cortex of developing ferrets with longitudinal imaging of GCAMP6s at both cellular resolution with two-photon calcium imaging and columnar resolution with widefield epifluorescence imaging. Prior to eye opening, we show that cellular and population responses evoked by single presentations of a grating stimulus surprisingly exhibit robust, modular patterns of network activity resembling activity patterns evoked by gratings in mature animals. However, the spatial location and pattern of domains activated by presentation of the identical stimulus orientation varies substantially across trials, a variability that accounts for the low orientation selectivity of individual neurons. The spatial layout of the evoked activity patterns prior to eye-opening is similar to spontaneous activity patterns on a fine spatial scale and across large ranges (>1mm). We show that trial-averaged activity patterns evoked by gratings show similarity to the mature orientation map several days prior to eye opening. We conclude that the early disassociation between stimulus orientation and consistent patterns of modular network activity is a major factor underlying the absence of orientation selectivity in a developing cortical network already exhibiting highly modular functional organisation.

Ádám Koblinger
Department of Cognitive Science, Central European University
Oktober 6 street 7, Budapest, 1051
Hungary

Koblinger_Adam@phd.ceu.edu; kob314@gmail.com

Perceiving Sudden Changes in Stimulus Statistics Dominates Decision-Making

Typically, perceptual decisions are influenced by prior knowledge based on accumulated evidence, especially when the incoming sensory information is ambiguous. Recently, we have shown that the dynamics of fluctuation in environmental statistics have a surprisingly strong effect on evidence accumulation. Specifically, depending on whether stepwise or gradual changes were introduced into task statistics, choice frequencies on ambiguous stimuli shifted in the opposite directions. This result cannot be explained by former models such as incremental evidence integration or statistical balancing between long- and short-term statistics. Here, I present a novel Bayesian model built on two ideas which can explain the results: First, people observing changes in regularities can either update their prior beliefs on external statistics or alternatively revise their confidence in their own perceptual system. Second, people have strong priors against rapid changes in external statistics. Hence, whenever they perceive a sudden jump in statistics they are more disposed to readjust their beliefs in the reliability of their own perceptions over accepting rapid changes occurring in statistics. In other words, they distort their likelihoods rather than changing their priors on the task statistics. However, when gradual changes happen, they have no reason to doubt the reliability of their perception; and therefore, they adapt to novel statistics. Our results show that humans use distinct strategies to revise their internal model depending on the characteristics of fluctuations in external statistics.

G. Vinodh Kumar

National Brain Research Centre
NH8 Manesar, Gurgaon - 122051
India

vinodh@nbrc.ac.in

Biophysically Realistic Neuronal Model Explains the Inter-Individual Differences in the Processing of Multisensory Speech

In a predominantly used paradigm of speech perception (McGurk effect), participants perceive illusory speech sound (cross-modal) when presented with incongruent audio-visual (AV) stimuli. However, a large number of participants rarely perceive the illusion. Notably, existing studies in the field primarily accentuate the correlation between subjective behaviour and cortical activations to reveal the neuronal mechanisms. Nonetheless, this approach does not provide a mechanistic explanation of the inter-individual differences. In our study, we explain our empirical observations of large-scale functional brain networks underlying cross-modal perception employing biophysically realistic neuronal models. Importantly, we propose how coupling between the key neuronal systems can explain the observed changes in functional connectivity pattern dynamics between frequent and rare perceivers of the McGurk effect. Overall, we present a mechanistic understanding of neuronal dynamics observed across a functional network comprised of multiple brain areas.

Praveen Kumar Bandela
Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad
India

bpraveen@lvpei.org

Visual Perception Alters in Patients with Poor Ocular Optics

Human vision is comprised of multiple visual components including form and depth vision. To perceive the world in a three dimensional view, both eyes should get clear and similar images. However, some people cannot achieve this due to various ocular conditions. Our research aims to understand this special and significant cohort of patients with Keratoconus, and subjects who have undergone corneal transplantation in one eye. The similar factor in all these subjects is the major optical component of the eye, i.e. the cornea is altered from its natural condition. We recruited these subjects and measured high contrast visual acuity, contrast sensitivity, ocular wavefront aberrations and, importantly, stereoacuity (depth perception) using psychophysical experimental design. Our results suggested that all the visual functions which we had measured in these subjects were hampered significantly with their best spectacle correction. Ocular waterfront aberrations were high in this cohort. These results were significantly different from age matched control subjects. However, if we correct these patients with rigid gas permeable (RGP) lenses, all the visual functions improved significantly. Surprisingly the improvement was not equal to the visual performance of normal subjects. We are further investigating to find out which factor contributes to the improvement in depth perception improvement and are specifically looking for the difference in the retinal image size. We further explore the reason why visual function improvement does not reach the level of a normal subject's performance.

Clara Kuper

Rolfslab: active vision and cognition
Bernstein Center for Computational Neuroscience, Humboldt University of Berlin
Philippstr. 13, Haus 6, 10115 Berlin
Germany

clara.kuper@posteo.de

Selective Enhancement of Orientation Tuning Before Saccades

When actively exploring a visual environment, humans shift their gaze from one point of a scene to another. These eye movements (saccades) are coupled with mandatory shifts of attention, causing an increase in visual performance in the vicinity of the saccade target. Changes in visual processing already occur before the onset of the movement, preparing the visual system for upcoming information. To determine if this pre-saccadic attention shift modulates perceptual orientation tuning curves, similar to attention-related changes in neuronal orientation tuning in the visual cortex, we compared the dynamics of perceptual tuning curves before saccade onset at the saccade target and in the opposite hemifield. Participants monitored a 30-Hz sequence of randomly oriented gratings for a target orientation. Combining a reverse correlation technique previously used to study orientation tuning in neurons with general additive mixed modelling, we found a spatially specific impact of saccade preparation on perceptual orientation tuning.

Perceptual reports revealed a tuning for the target orientation at both the location of the saccade target and in the opposite hemifield. Importantly, at the saccade target, we observed an enhancement of the orientation profile starting 100 ms before saccade onset and finer tuning right before saccade onset. In the opposite hemifield, such modulations did not occur — instead we observed that orientation tuning washed out over time. These findings suggest that pre-saccadic attention boosts the encoding of visual signals at the saccade target by enhanced and sharper perceptual orientation tuning emerging during movement preparation.

José Ossandón
Biological Psychology and Neuropsychology
University of Hamburg
Von Melle Park 11, 20146 Hamburg
Germany

jose.ossandon@uni-hamburg.de

Transsaccadic Paradoxical Confidence in Unreliable Filled-In Sensory Information

For optimal decision-making, animals evaluate sensory signals according to their reliability. This is apparent both at the behavioural and neurophysiological level after the manipulation of inputs' signal-to-noise ratio. However, it is not clear how we evaluate percepts that are unreliable not due to extrinsic noise but because they are generated in the absence of a direct external signal.

We used the phenomenon of filling-in occurring at the physiological blind spots to compare partially inferred and veridical percepts. Subjects chose between stimuli that elicit filling-in and perceptually equivalent ones presented outside the blind spots, looking for a Gabor stimulus without a small orthogonal inset. In ambiguous conditions, when the stimuli were physically identical and the inset was absent in both, subjects behaved opposite to optimal, preferring the blind spot stimulus as the better example of a collinear stimulus, even though no relevant veridical information was available.

A parallel electrophysiological experiment demonstrated that, at least at the level of transsaccadic predictions of sensory information, there is information available about the unreliability of filled-in percepts, but this emerges only at late stages of processing. Together, these experiments suggest that sensory decision-making is normally based solely on low-level comparisons, without taking into account implicit assessments of reliability. This can result in suboptimal decisions in which a percept that is inferred from surrounding information is paradoxically considered more reliable than a percept based on a direct external input.

Kabilan Pitchaimuthu

Biological Psychology and Neuropsychology
University of Hamburg
Von Melle Park 11, 20146 Hamburg
Germany

kpitchaimuth@student.unimelb.edu.au

Foveal Centre Surround Contrast Suppression Reveals Differential Effect of Ageing on Intraocular and Interocular Suppression

Healthy ageing alters centre surround contrast suppression. The neural basis of centre surround contrast suppression is considered to reflect several primary visual cortex (V1) neuronal receptive field properties. Primate V1 neurons have distinct transient/sustained (Bair et al., 2003) and early/late (Webb et al., 2005) surround suppression mechanisms. Here, we tested whether similar properties are manifest for perceptual surround suppression and if so, are they altered by healthy ageing? We measured the apparent contrast of a circular vertically oriented sinusoid (20% contrast, 4c/deg) alone or in the presence of an annular sinusoidal surround (40% contrast, 4c/deg). Eighteen younger (aged 19–32) and eighteen older (aged 61–78) adults were tested under two viewing conditions (intraocular: centre-surround in both eyes; interocular: centre-surround in different eyes), two surround configurations (No/Parallel surround) and two stimulus durations (40ms/200ms). Suppression strength was calculated as Apparent $\text{Contrast}_{\text{No Surround}}$ – Apparent $\text{Contrast}_{\text{Parallel Surround}}$. In both groups, using intraocular viewing, stimulus durations of 40ms produced stronger suppression than 200ms, however, both stimulus durations produced similar amounts of suppression interocularly (stimulus duration X viewing condition: $F(1,34)=10.6$, $P<0.01$). For both stimulus durations, older adults showed increased intraocular suppression relative to the younger group, however, interocular suppression was similar (age X viewing condition: $F(1,34)=6.75$, $P=0.01$, age X stimulus duration: $F(1,34)=5.49$, $P=0.03$). Our data suggests that ageing alters surround suppression at a processing stage before binocular combination of visual signals, either prior to or including the input layers of V1.

Suddha Sourav
Biological Psychology and Neuropsychology
University of Hamburg
Von Melle Park 11, 20146 Hamburg
Germany

suddha.sourav@uni-hamburg.de
http://www.bpn.uni-hamburg.de

Evidence for an Intact Retinotopic Organization of Early Visual Cortex but Impaired Extrastriate Processing in Sight Recovery Individuals

Congenital visual deprivation has been shown to cause extensive structural and functional changes in the brain and impair the ability to acquire numerous visual functions if vision is subsequently restored. However, some recent findings have suggested that certain neural systems can emerge in the absence of developmental vision. Using visual event-related potentials (VERPs) in a population of individuals with a history of bilateral, dense congenital cataracts (CC) who subsequently underwent cataract removal surgeries, we investigated whether basic retinotopic processing in the early visual cortex can emerge after congenital visual deprivation.

Cataract-reversal individuals and control individuals took part in an experiment in which grating stimuli were flashed in one of the four quadrants of the visual field. Rare visual stimuli served as behavioural targets and electroencephalographic data were recorded during the experiment. The first wave in VERPs to such stimuli, the C1 wave, is known to exhibit a polarity reversal based on upper vs. lower field presentation, attributed to early visual processing in the calcarine sulcus. Later, extrastriate waves like P1 do not show this reversal. We statistically compared the C1 and the P1 waves between cataract and control groups. C1 wave polarity was dependent on stimulus location in the visual field and had typical latency in all groups, indicating that basic retinotopic processing is spared in the CC group. The P1 wave, however, was found to have reduced amplitude in the CC group compared to their controls. Individuals with developmental cataracts, or congenital but incomplete cataracts did not show any significant reduction in P1 wave amplitude.

Thus, the retinotopic representation of the upper and lower visual fields in the primary visual cortex seems to be spared in CC individuals. Moreover, we found evidence that basic retinotopic processing occurs with typical latency in the CC group, suggesting an impressive recovery of the early visual cortex after sight restoration. In contrast, extrastriate processing indicated by the P1 wave did not seem to recover to the same degree following congenital bilateral visual deprivation.

Acknowledgment: This study was supported by the European Research Council (ERC-2009-AdG 249425-CriticalBrainChanges).

Rebecca Sumalini
Institute for Vision Rehabilitation, Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad
India

rebecca@lvpei.org

Hypoaccommodation and Near Visual Acuity in Children with Down Syndrome

A few studies have shown improved academic performance after prescribing bifocals for children with Down syndrome (DS) with hypoaccommodation. Hypoaccommodation is said to be present when eyes appear to focus farther away than where the target is. In India, prevalence for hypoaccommodation in children with DS is not known, neither is prescribing bifocals a common practice. We undertook vision screenings to determine if children with DS have hypoaccommodation and whether they were prescribed bifocals. Screenings were conducted in 4 schools for children with special needs in Hyderabad, India. One screening was held as part of the Special Olympics Bharat-Opening Eyes program in Visakhapatnam, India. In addition to the conventional vision screening tests, the accommodative status was assessed by performing the Nott dynamic retinoscopy technique. A total of 55 participants with DS that included 33 children (age <18 years) were screened. Twenty-two participants had visual impairment (WHO classification for low vision). Uncorrected refractive error was found in 40% of the participants. Accommodative accuracy was assessed in 29 children and 17 adults. Accommodative lag (≥ 1.00D), indicating hypoaccommodation was present in 12 out of 29 children (41.37%) and 7 out of 13 adults (53.84%) on whom it was measured. No correlation was found between hypoaccommodation and near acuity. This indicates that a child with hypoaccommodation may have a good measure of near acuity, but may still have problems for sustained near vision tasks such as reading. This could also explain why many children with DS are not prescribed bifocals, because of the measure of good near acuity.

Pavan K. Verkicharla
Myopia Research Lab, Brien Holden Institute of Optometry and Vision Sciences
L V Prasad Eye Institute, Hyderabad,
India

pavanverkicharla@lvpei.org

Posterior Eye Shape Varies with Refractive Error: Quantification Using Magnetic Resonance Imaging

Retinal shape has been reported to have an association with refractive errors and is considered important in myopiogenesis. The purpose of the study was to quantify the posterior eye shape using magnetic resonance imaging (MRI) and investigate how it changes in different refractive error groups. Study subjects were enrolled from the Singapore Epidemiology of Eye Diseases study. Brain MRI T2-images were acquired as part of the Epidemiology of Dementia in Singapore study using a 32-channel head coil. After exclusions, there were 259 adults (mean age: 65.5±6.5 years) with 113 from Malay ethnicity and 146 from Chinese ethnicity with 65 myopes (SE≤-0.75D), 70 emmetropes and 124 hyperopes (SE≥+0.75). Spherical equivalent refraction ranged from +4.50D to −10.75D. The right eye in the MRI images was automatically segmented and fitted to the sphere to quantify the posterior eye shape in terms of the radius of curvature (Rc). Rc was significantly smaller (steeper retina) in myopes compared to emmetropes (mean±SD: 9.83±0.6 mm vs. 10.58±0.91 mm, $p<0.001$) and hyperopes (9.83±0.5 mm vs. 10.63±0.6 mm, $p<0.001$). There was a difference in Rc between hyperopes and emmetropes ($p=0.69$). There was a tendency for the Rc to decrease with increasing degree of myopia at a rate of 0.13 mm/diopter ($p=0.01$). The results indicate that the posterior eye was steeper in myopes than in emmetropes and hyperopes. Differences in the posterior shape of the eye between myopia and the other refractive error groups (with no differences in Rc between hyperopes and emmetropes) suggest a potential role of posterior eye shape in myopia.

Paul Zerr

Biological Psychology and Neuropsychology
University of Hamburg
Von Melle Park 11, 20146 Hamburg
Germany

p.zerr@uu.nl

Error Compensation in Random Vector Double Step Saccades With and Without Global Adaptation

In saccade sequences without visual feedback, endpoint errors pose a problem for subsequent saccades. Accurate error compensation has previously been demonstrated in double step saccades (DSS) and is thought to rely on a copy of the saccade motor vector. However, these studies typically use fixed target vectors on each trial, calling into question the generalisability of the findings due to the high stimulus predictability. We present a random walk DSS paradigm (random target vector amplitudes and directions) to provide a more complete, realistic and generalizable description of error compensation in saccade sequences. We regressed the vector between the endpoint of the second saccade and the endpoint of a hypothetical second saccade that does not take first saccade error into account on the ideal compensation vector. This provides a direct and complete estimation of error compensation in DSS. We observed error compensation with varying stimulus displays that was comparable to previous findings. We also employed this paradigm to extend experiments that showed accurate compensation for systematic undershoots after specific-vector saccade adaptation. Utilising the random walk paradigm for saccade adaptation by Rolfs et al. (2010) together with our random walk DSS paradigm, we now also demonstrate transfer of adaptation from reactive to memory-guided saccades for global saccade adaptation. We developed a new, generalizable DSS paradigm with unpredictable stimuli and successfully employed it to verify, replicate and extend previous findings, demonstrating that endpoint errors are compensated for saccades in all directions and variable amplitudes.

Katharina Zinke

Institute of Medical Psychology and Behavioural Neurobiology, University of Tuebingen
Silcherstr. 5, 72076 Tuebingen
Germany

katharina.zinke@uni-tuebingen.de
https://www.medizin.uni-tuebingen.de/en/Referral+Guide/Institutes/Medical+Psychology.html

Sleep Augments Training-Induced Improvement in Working Memory in Children and Adults

Sleep plays an important role in forming procedural memories for skills. The role of sleep for procedural memories in the cognitive domain, like working memory, is not yet clear. Here we investigated if sleep enhances training-induced improvements in working memory in children. Because children show more intense slow wave sleep we expected sleep-related improvements to be greater than in adults. Twenty-four children (10–12 years) and 24 adults were trained on three sessions of an n-back task comprising three runs of blocks (6 blocks with 20 responses each) presented in ascending levels of difficulty. The sessions were separated by ~12h. Between the training sessions, participants first spent a full night sleeping and then a normal day awake (evening groups) or vice versa (morning groups). To estimate working memory capacity, we analysed performance on the whole blocks and, to estimate the individual's optimum performance, on only the first 10 trials of each block. Results showed a distinct gain in training-induced working memory performance with post-training overnight sleep compared to wakefulness. The sleep-induced gain was revealed only for performance on the first block-halves and, in absolute terms, was closely comparable in children and adults. Taking differences in working memory performance into account sleep-dependent gains expressed as percentages of baseline performance were, however, greater in children than in adults. The data thus indicate that sleep after training facilitates procedural memories in the executive control domain, i.e., the capacity to operate sequences of events in working memory, with a particular benefit in developing populations.

Appendix: Resumes
(in alphabetical order)

Sripati Panditaradhyula ARUN

SP Arun received his B.Tech from the Indian Institute of Technolgoy (IIT) Bombay, and MS & PhD from Johns Hopkins University, all in Electrical Engineering. He completed his postdoctoral research at Carnegie Mellon University, USA and joined the Centre for Neuroscience at the Indian Institute of Science (IISc) where he is currently an Associate Professor. His interests are in understanding visual perception and object recognition in the brain.

Dorairajan BALASUBRAMANIAN

Distinguished Scientist & Director of Research Emeritus, L V Prasad Eye Institute (LVPEI), Kallam Anji Reddy Campus, L V Prasad Marg, Hyderabad – 500 034, India, Phone: +91 040 23543652, Fax: +91 40 23548271, Email: dbala@lvpei.org, Website: www.lvpei.org

Professor Dorairajan Balasubramanian obtained his PhD degree in chemistry from Columbia University in 1965, and spent a year at the Minnesota Medical School as a Jane Coffin Memorial Fellow studying the structural properties of proteins. He returned to India in 1967 and first taught at the Indian Institute of Technology Kanpur (1967–77), and moved to become Professor and Dean at the University of Hyderabad in 1977. He joined the Centre for Cellular & Molecular Biology (CCMB), Hyderabad in 1982 as Deputy Director and served as its Director during 1992–1998, when he took early retirement to join the L V Prasad Eye Institute as its Director of Research, where he conducts and directs research on the biology of the eye. He is an elected Fellow of all the three Science academies of India, and Fellow of the German National Academy of Sciences Leopoldina, The World Academy of Sciences for the Developing World (TWAS), the American Association for the Advancement of Science (AAAS), the African Academy of Sciences (AAS) and the Mauritian Academy of Science & Technology. His particular research interest has been the proteins of the human lens and the role they play in the development of the eye.

Arpan BANERJEE

Arpan Banerjee received his PhD in Complex Systems and Brain sciences from Florida Atlantic University, USA primarily working in the area of bimanual motor coordination in humans. He has completed his post-PhD training at the Center for Neural Sciences, New York University and The National Institutes of Health, USA working in signal processing and spike train, LFP and MEG recordings. Currently, his interests are in using computational neuroscience and multimodal brain imaging EEG/MEG/fMRI to understand accurately where (spatial) and when (temporal) task-related differences in information processing occur in the brain during multisensory integration, higher order visual processing and cognition. The key research question that he wants to address is how large networks of neurons coordinate amongst each other to form organised assemblies at only specific instants of time to orchestrate ongoing behaviour. Demystifying the tunes that govern this neural orchestra will shed light on subtle differences in human brain function across normal individuals, across patients and eventually lead to developing neuro-markers for spectrum disorders such as autism.

Upinder S. BHALLA

I studied Physics as an undergraduate at IIT Kanpur and then Cambridge University, but I developed an interest in biology during my bachelors. I switched to experimental and computational neuroscience for my PhD at Caltech in the lab of Jim Bower. I have been combining models and experiments ever since. Toward the end of my PhD, I became interested in the computational possibilities of chemical signalling networks in brain function and especially memory. Entirely by accident, I stumbled into modelling the chemical signalling events in synaptic plasticity during my post-doc with Ravi Iyengar at Mount Sinai. This was back in the dawn of what is now called Systems Biology. I currently work on multiscale (chemical, electrical, and network) processes in memory using experimental and computational methods. I am investigating the role of brain activity sequences in information processing and memory and I am intrigued by the parallels between neuronal computation of sequences, and deep learning algorithms.

Shrikant R. BHARADWAJ

Dr. Shrikant Bharadwaj completed his undergraduate degree in Optometry at the Elite School of Optometry, Birla Institute of Technology and Science, Pilani and obtained a PhD in Vision Science from the University of California Berkeley School of Optometry, USA. After completing his post-doctoral training in Vision Science at the Indiana University School of Optometry, USA Bharadwaj returned to the L V Prasad Eye Institute (LVPEI) in Hyderabad as a DBT Ramalingaswami Fellow in 2009. He has since then established the Visual Optics research laboratory at LVPEI with the overall agenda of understanding how the optics of the eye influences spatial vision and depth vision. Bharadwaj uses a combination of experimental, behavioural and computational techniques to address this research agenda. His laboratory actively publishes research work in international peer reviewed vision science journals and the research work is generously supported by extramural grants from the Department of Science and Technology and Department of Bio-Technology and from the optical industry. Bharadwaj also serves on the editorial board of Nature Scientific Reports, Optometry and Vision Science and the Indian Journal of Ophthalmology.

In addition to his research work, Bharadwaj also serves as Director of the Brien Holden Institute of Optometry and Vision Sciences, L V Prasad Eye Institute and teaches at the institute's Bausch & Lomb School of Optometry.

Chiranjib BHATTACHARYA

Chiranjib Bhattacharya is currently Professor in the Department of Computer Science and Automation, Indian Institute of Science (IISc). His research interests are in Machine Learning, Optimisation and their applications to industrial problems. Recently, he was inducted as a fellow of the Indian Academy of Engineering.

He joined the Department of CSA, IISc, in 2002 as an Assistant Professor. Prior to joining the department he was a postdoctoral fellow at UC Berkeley, California, USA. He holds BE and ME degrees, both in Electrical Engineering, from Jadavpur University and the IISc, respectively, and completed his PhD at the Department of Computer Science and Automation, IISc.

Jan BORN

Jan Born is director of the Department of Medical Psychology and Behavioural Neurobiology at the University of Tuebingen, Germany. He obtained PhDs in Psychology and Physiology. After stays at the State University of New York at Stony Brook and the Department of Physiology at the University of Ulm, he was appointed full professor of Physiological Psychology at the University of Bamberg in 1989. In 1999, he joined the Department of Neuroendocrinology at the University of Luebeck, and changed in 2010 to his current position. Born's primary research interests are in the dynamics of memory formation in biological systems. He is particularly interested in the memory functions that sleep serves for the central nervous system and the immune system. In 2010, he received the Leibniz award of the Deutsche Forschungsgemeinschaft (DFG, German Research

Foundation). Dr Born has co-authored more than 500 publications. He is a member of the German National Academy of Sciences Leopoldina.

Vijay Reena DURAI

Reena Durai received her Bachelor's degree in Optometry from the Sri Ramachandra Medical College (SRMC), Chennai and a Master's degree in Optometry from Manipal University College of Allied Health Sciences (MCOAHS). She graduated as a topper consecutively for two years during her Master's degree training and received the gold medal for the best outgoing student in 2016. In the same year, Durai joined the Vision Psychophysics Laboratory, Brien Holden Institute of Optometry and Vision Sciences, L V Prasad Eye Institute as an Assistant Optometrist. Her current research work focuses on neural adaptation to motion-related depth illusion in patients with interocular differences in image quality (e.g. unilateral cataract). This work will have implications for how temporal binocularity is maintained in the presence of interocular differences in image quality.

Kurni ESWAR

Kurni Eswar is an adjunct optometrist at Brien Holden Institute of Optometry and Vision Science, L V Prasad Eye Institute, Hyderabad, India. Eswar obtained a first class with distinction honours degree in optometry and vision sciences from the University of Hyderabad, India in 2017. During this time, he was also awarded a young student research award by the India Vision Institute to study "reflexive eye movements as a measure of visual function". His research interest is to study eye movements and visual functions of children with special needs. Alongside his research work, Eswar also sees patients in cataract services in L V Prasad Eye Institute.

József FISER

József Fiser received his Diploma in Electrical Engineering at TU Budapest, his MA in Cognitive Psychology and PhD in Computer Science at the University of Southern California and his postdoctoral training in neuroscience, infant research and visual psychophysics at the University of Rochester. He held a position of Assistant Professor in psychology at the Volen Center for Complex Systems at Brandeis University before joining the newly formed Department of Cognitive Science at Central European University, CEU. He was awarded various fellowships (Soros, MacDonnell-Pew, Schmitt, Collegium Budapest Institute for Advanced Study), and grants (NIH R01, R21, NSF, Marie-Curie). In 2007, he became the grand doctor of the Hungarian Academy of Sciences, and in 2016, he was a Visiting Fellow Commoner of Trinity College at the University of Cambridge. Fiser's research is focussing on visual perception, visual learning and neural coding of visual representations. He approaches these topics from behavioural, neurophysiological and computational perspectives. His main research areas are visual perceptual, statistical and rule learning in adults, infants and animals, multi-electrode recordings from the visual system of ferrets and rats, computational studies of probabilistic coding in the brain, and more recently, sequential decision making and multi-modal cue integration.

Shonraj Ballae GANESHRAO

Dr Shonraj Ballae Ganeshrao is a post-doctoral researcher at Kallam Anji Reddy Campus, Hyderabad. Shonraj completed his Bachelors and Masters degree in Optometry from the Elite School of Optometry – Birla Institute of Technology and Science (BITS), Pilani, India and did his PhD in Vision Science at the University of

Melbourne, Australia. His areas of specialization are visual fields, the structure-function relationship in glaucoma, and changes in the visual field with progression of glaucoma. Ganeshrao's PhD thesis involved developing novel computer algorithms in perimetry for faster and a more sensitive detection of visual field loss in glaucoma.
Currently, Ganeshrao is associated with LVPEI's VST Centre for Glaucoma care and is involved in initiating and completing projects for the department. He is also teaching actively at the Bausch & Lomb School of Optometry, Brien Holden Institute of Optometry and Vision Sciences.

Maria J. S. GUERREIRO

Maria Guerreiro was born on December 11, 1984, in Albufeira, Portugal. In 2006, she completed her licentiate's degree in Psychology (cum laude) at the University of Algarve, Portugal, having been awarded a merit scholarship for the top senior students of the academic year 2005/2006. During her licentiate's degree, she was also awarded an Erasmus scholarship for a six-month exchange at the University of Turin, Italy, where she took several courses on Neuropsychology. While in Italy, she decided that her next step would be to do a research master in Cognitive Science at the University of Amsterdam, the Netherlands, which she completed (cum laude) in 2008. During this period, she was awarded a merit scholarship from the Huygens Scholarship Program for talented international students. Shortly after graduation, she began her PhD in Neuropsychology at Maastricht University, the Netherlands, which she completed (cum laude) in 2013. In the last year of her PhD project, she was a visiting researcher at the University of California, San Francisco, USA for which she was awarded two travel grants, one by Boehringer Ingelheim Fonds and the other by the Luso-American Development Foundation.
Since 2013, Maria Guerreiro works as a post-doctoral researcher in the research group Biological Psychology and Neuropsychology of the University of Hamburg, Germany where she investigates the impact of early sensory deprivation on functional and structural brain organisation.

Bettina HEIN

Since October 2013, Bettina Hein is a PhD student in Matthias Kaschube's group at the Frankfurt Institute for Advanced Studies (FIAS). In collaboration with the Fitzpatrick lab at the Max Planck Florida Institute, she is currently investigating the development of the functional organisation of the visual cortex, combining data analysis and neural network modelling. She is also a Graduate student at the International Max Planck Research School (IMPRS) for Neural Circuits at the Max Planck Institute for Brain Research, Frankfurt am Main, Germany one of the most competitive graduate schools for neuroscience in Germany. She is a student representative at FIAS and jointly organises science outreach programmes, student seminars and scientific retreats. For instance, she is organising the weekly institute-wide tea afternoon to promote scientific exchange across disciplinary boundaries. 2010–2013: Bettina Hein holds a Master's degree in Physics from the University of Würzburg, Germany with the thesis "Comparing a disorder ensemble with superconducting noise terms with the KPZ equation" in theoretical physics, supervised by Reinhold Oppermann. She graduated in February 2013 (with distinction). Between August 2010 and August 2011, she was awarded a DAAD fellowship and spent one year as visiting Graduate Student in Physics at Rutgers, the State University of New Jersey. 2007–2010: She did her undergraduate studies in Physics at the University of Würzburg, Germany and graduated in August 2010 with the thesis "Characterization of metallic scattering particles in organic polymer systems".

Soumya IYENGAR

Soumya Iyengar completed her doctoral studies at the University of Southern California (Los Angeles, USA) on the development and organisation of the anterior forebrain pathway which is important for song learning in zebra finches. After her PhD, she worked on the connections of the representation of the oral cavity in the somatosensory cortex of new world monkeys (Prof Jon Kaas's lab, Vanderbilt University, Nashville, USA). The main focus of research in her lab at the National Brain Research Centre (NBRC), Manesar is to study the neural basis of hearing and vocal behaviours during development. She and her team use a combination of neuroanatomical and molecular techniques on the postmortem human auditory cortex at different ages to understand when different neuronal subtypes and synapses are established and the changes that they undergo over the course of development. They are also interested in understanding and correlating changes in neural circuits underlying vocalisation, vocal learning and cognition in songbirds such as zebra finches and crows. They are, at present, investigating the effects of opioid neuromodulation on singing and song learning in zebra finches. Other projects are focused on testing the abilities of house crows on various tasks to test their discriminative abilities using visual and auditory cues and to study the structure of their brains using neuroanatomical methods and magnetic resonance imaging.

Neeraj JAIN

Neeraj Jain did his PhD in Biochemistry, and worked at the Centre for Cellular and Molecular Biology, Hyderabad, before moving to Vanderbilt University, USA for his Post-Doctoral work with Prof Jon Kaas. He returned to India to join the National Brain Research Centre after receiving an International Senior Research Fellowship from the Wellcome Trust, UK. His research interests include organization and information processing in the sensorimotor systems, and brain plasticity following spinal cord injuries. His lab uses many different model systems including non-human primates, rats, mice and humans, and a variety of experimental approaches that include electrophysiology, neuroanatomy, multi-photon imaging and fMRI.

Matthias KASCHUBE

Matthias Kaschube is a Fellow at the Frankfurt Institute for Advanced Studies and a Professor for Computational Neuroscience in the Institute of Computer Science at Goethe University Frankfurt. He studied Physics and Philosophy in Frankfurt and Goettingen and obtained his doctoral degree working with Fred Wolf and Theo Geisel at the Max Planck Institute for Dynamics and Self-Organization in Goettingen. After his doctoral studies he became a Fellow at the Bernstein Center in Goettingen. Half a year later, he moved to Princeton University where he held the position of a Lewis-Sigler Theory Fellow for a period of five years, working on theoretical neuroscience and developmental biology. In 2011, he started his current position in Frankfurt. His research interests are, broadly speaking, the assembly, function, and maintenance of brain circuits. One strong focus of his research is on development and functional organisation of the visual cortex. Other topics include the structural stability of sensory representations in cortical networks, and visual texture processing in cuttlefish. His approach is data-driven computational neuroscience and he conducts his research projects in close collaboration with neurobiologists.

Tara KECK

Tara Keck studied engineering at Harvard University and then completed her PhD in biomedical engineering at Boston University, where her research focused on neural computation in the hippocampus. She next did post-doctoral research at the Max Planck Institute of Neurobiology in Munich with Mark Huebener and Tobias Bonhoeffer, where she focused on cortical plasticity following peripheral input loss. In 2010, she moved to the Centre for Developmental Neurobiology at King's College London to start her own lab with a Career Development Fellowship from the Medical Research Council. In 2014, she moved her lab to the Department of Neuroscience, Physiology and Pharmacology at University College London, where she is currently a Principal Research Fellow. Her work focuses on the mechanisms of plasticity in the mouse visual cortex from the level of synapses to networks. She uses a combination of in vivo two-photon imaging of cellular function and structure, together with ex vivo electrophysiology and immunohistochemistry to examine the interactions of excitatory and inhibitory neurons and how they facilitate the initiation of cortical plasticity after input loss.

Ádám KOBLINGER

Ádám Koblinger is a PhD student in the Department of Cognitive Science at the Central European University in Hungary, and is working on mathematical modelling of visual perception and decision making under the supervision of József Fiser and Máté Lengyel.

He is interested in understanding what the computational mechanisms are that allow humans and animals to efficiently process inherently ambiguous and noisy sensory information, and how these computations are implemented in the brain. He uses probabilistic Bayesian models to approach these questions on the different levels of analyses. On the computational level, he works on models to describe how humans integrate uncertain information from sequential observations in an environment with unstable statistical properties. On the algorithmic level, Ádám Koblinger is investigating efficient algorithmic realizations of the abstract Bayesian computations that can account for various top-down effects observed in visual cortex. More specifically, he is testing task-dependent sampling strategies that are optimised to represent complex posterior distributions for resource constrained inference systems.

Martin KORTE

Martin Korte studied biology in Muenster, Tuebingen, Germany and at the NIH, Bethesda, Maryland, USA. He focused on synaptic plasticity during his PhD projects "Signaling Systems at hippocampal synapses" at the Max Planck Institute (MPI) of Neurobiology in Martinsried, Germany. Afterwards, he became a research group leader at the MPI of Neurobiology. In 2004, Martin Korte got the professorship of animal physiology at the Technical University (TU) Braunschweig. Since 2007, he is professor of cellular neurobiology and the director of the zoological institute at the TU Braunschweig. From 2010 to 2012, he was vice president of the TU Braunschweig. In 2012, he became an elected member of the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW). That same year, he established the research group neuroinflammation and neurodegeneration at the Helmholtz Centre for Infection Research, connecting his experience in the fields of cellular neurobiology and neurophysiology with the areas of infection and neurodegenerative diseases.

G. Vinodh KUMAR

G. Vinodh Kumar received his B.Tech in Biotechnology from Bharathidasan University, Trichy, India. During his B.Tech dissertation, he was involved in understanding the plasticity of intrinsically disordered proteins during amyloidogenesis at the Indian Institute of Science Education and Research, Mohali, India. He is currently pursuing his PhD at the National Brain Research

Centre, India under the tutelage of Dr Arpan Banerjee. His primary research interests involve deciphering the markers that underlie multisensory speech perception at different levels of neuronal organization. He is also interested in understanding how our prior experiences modulate perception of the world. Decoding these neuronal mechanisms has major implications in speech related and autism spectrum disorders.

Praveen KUMAR BANDELA

Praveen Kumar Bandela received his Bachelor's degree in general science from Osmania University, followed by a Bachelor's degree in Optometry from LVPEI's Bausch & Lomb School of Optometry, affiliated to the Birla Institute of Technology & Science, Pilani. He was awarded a gold medal for being the best outgoing student in his Optometry batch. He has been associated with LVPEI since 2012 in the capacity of Research Optometrist and Consultant Optometrist, Cornea and Anterior Segment Services. His research interests include Visual Optics, Psychophysics and Binocular Vision. His current research involves studying the visual functions in patients with distorted optics of the eyes, specifically conditions like Keratonous and post corneal transplantation in one eye. He has participated in national and international conferences and has also received several travel grants. Praveen is also actively involved in teaching at the LVPEI Bausch & Lomb School of Optometry. Apart from his clinical work, he writes software programmes for assessing visual functions and studies statistical trends in the field of medicine.

Clara KUPER

Clara Kuper was born in 1994 in Berlin and completed her Bachelor of Science (Biology) at Freie Universitaet Berlin in 2016. Being curious about the biological underpinnings of human behaviour and cognition, she continued her studies with the Master Programme "Social Cognitive and Affective Neuroscience" at Freie Universitaet Berlin. In 2016, she wrote her Bachelor Thesis about perceptual orientation tuning before saccades in the Emmy-Noether Group of Dr Martin Rolfs at Humboldt University of Berlin and stayed with that group as a student assistant. She will continue and finish her Master studies in the Nencki Institute of Experimental Biology in Warsaw, Poland within the research group of Dr Artur Marchewka, working on functional and plastic changes in the brain during acquisition of a second language. She is particularly fascinated by the question of how to use the broad range of neurocognitive methods – such as Psychophysics, Eye-Tracking, fMRI and EEG – in combination with statistics to answer questions about perception, cognition and behaviour. In the future, she would like to take such questions from the lab into more natural settings, studying cognitive skills as they interact with the dynamically changing environment in which they evolved.

Máté LENGYEL

Máté Lengyel is a Professor in Computational Neuroscience at the Department of Engineering, University of Cambridge, and a Senior Research Fellow at the Department of Cognitive Science, Central European University. Máté's interests span a broad range of levels of nervous system organisation, from sub-cellular and cellular through circuit and systems to behaviour. He studies these phenomena from computational, algorithmic/representational and neurobiological viewpoints. Computationally and algorithmically, he uses ideas from Bayesian approaches to statistical inference and reinforcement learning to characterise the goals and mechanisms of learning in terms of normative principles and behavioural results. He also performs dynamical systems analyses of reduced biophysical models to understand the mapping of these mechanisms into cellular and network models. Lengyel obtained his MSc and PhD at the Eötvös Loránd University, followed by a post-doctoral research fellowship at the Gatsby Computational Neuroscience Unit, University College London, and a visiting research fellowship at the Collegium Budapest Institute for Advanced Study. He has been awarded an Investigator Award by the Wellcome Trust, and a Consolidator Grant by the European Research Council.

Aditya MURTHY

My undergraduate training was at St. Xavier's college, Mumbai and Bombay University where I obtained my Master's degree. My doctoral training was with Dr Allen Humphrey in the Department of Neurobiology at the University of Pittsburgh where I examined the neural mechanisms involved in the processing of motion in the visual system. For my postdoctoral training, I worked with Dr Jeffrey Schall at Vanderbilt University, USA studying the primate visuomotor system to more directly relate neural activity to psychological functions and behaviour. I was a faculty member at the National Brain Research Centre, Manesar prior to joining the Centre for Neuroscience, Indian Institute of Science, Bengaluru.

My research interest focuses on Brain Mechanisms of Motor Control. Our lab studies the neural and computational basis of movement planning and control with an emphasis on understanding the basis of flexibility and control that is the hallmark of intelligent action. From the perspective of behaviour, we seek to understand the nature of computations that enable motor control; from the perspective of the brain, we seek to understand the contribution of circumscribed neural circuits to motor behaviour; and by recording the electrical activity of neurons and muscles we seek to understand how such computational processes are implemented by the brain. Our research interests span the fields of visual perception, decision-making, and the generation of motor behaviour and involve the application of cognitive/psychophysical, neuropsychological and electrophysiological techniques. We anticipate that in the long term this work will be useful to understand the basis of different motor disorders and develop brain-machine interface systems that are only beginning to be exploited as engineering and brain sciences are starting to increasingly interface.

José OSSANDÓN

José P. Ossandón studied Medicine and received a MSc degree in Biomedical Science from the University of Chile. Afterwards, he received a PhD in Cognitive Science from the University of Osnabrueck (Germany); and since 2016, he is a postdoc at the Biological Psychology and Neuropsychology department of the University of Hamburg.

Ossandón's research focuses on the mechanisms of visual selection and integration of visual information, across time and with other sensory modalities. He pursues these interests by doing research with human subjects and combining multiple behavioural and electrophysiological techniques.

Kabilan PITCHAIMUTHU

Kabilan Pitchaimuthu recently finished his doctoral thesis at the Department of Optometry and Vision Sciences, University of Melbourne, Australia. Kabilan got his bachelor's and master's degrees in optometry from the Elite School of Optometry, India. After working as a research optometrist in the Medical Research Foundation in Chennai, India, he pursued a PhD on exploring the effects of healthy ageing on various suppression mechanisms in vision using a combination of psychophysical and neuroimaging methods. He is currently working as a post-doctoral research associate in the department of Biological Psychology and Neuropsychology at the University of Hamburg.

Research interests of Pitchaimuthu include spatial vision, contextual interactions in vision, cortical changes in development and ageing, paediatric visual anomalies such as congenital cataract and amblyopia.

Brigitte ROEDER

Brigitte Roeder studied Psychology at and received her PhD from the University of Marburg (Germany). After her postdoc time at the University of Oregon (USA) she was awarded an Emmy-Noether grant of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation). In 2004, she moved to the University of Hamburg where she holds a full professorship for Biological Psychology and Neuropsychology with a second affiliation at the Medical Faculty of the University of Hamburg. Brigitte Roeder's research interests comprise multisensory processes and age-dependent neuroplasticity. Her main research methods include behavioural, electrophysiological techniques and brain imaging.

Brigitte Roeder is a member of the German National Academy of Sciences Leopoldina and of the Academy of Sciences in Hamburg. Her most important awards are the Leibniz Award of the DFG and an Advanced Grant of the European Science Foundation.

Frank ROESLER

Frank Roesler studied Psychology at the University of Hamburg. He received his PhD in 1975 from the Christian-Albrechts-University of Kiel (Germany) where he also finished his second dissertation (Habilitation) in 1983. After research visits in the USA and Australia and a substitute professorship at the University of Hamburg, he became a full professor for Experimental and Biological Psychology at the Philipps-University Marburg (Germany) in 1986. After retirement in 2010, he served for 3 years as a Senior Professor for Experimental and Biological Psychology at the University of Potsdam (Germany). Since 2013, he is Senior Professor at the unit for Biological Psychology and Neuropsychology at the University of Hamburg (Germany). His research interests focus on biological correlates of perception, memory, language, and development by using electroencephalography and MRI to monitor brain activity. Frank Roesler is member of the Berlin-Brandenburg Academy of Sciences and of the German National Academy of Sciences Leopoldina. Among others he received the Wilhelm-Wundt Medal of the German Society for Psychology (DGPs), the Max-Planck-Prize for International cooperation, and he was honoured with the Life-time award of the German Society for Psychology (DGPs). Currently he is a member of the executive committee of the German National Academy of Sciences Leopoldina.

Martin ROLFS

Martin Rolfs' research focuses on active vision and cognition. He contends that our understanding of perception greatly benefits from studying its key processes in observers that actively engage with their environment. He obtained his PhD from the University of Potsdam (Germany) in 2007. For his thesis on the control of micro-movements of the eyes, he received the Heinz Heckhausen Award (the German Psychological Society's biennial award for an outstanding dissertation). In 2008, he joined Patrick Cavanagh's group at the Laboratoire Psychologie de la Perception in Paris. Their work on the attentional basis of perceptual continuity across eye movements has had a strong and lasting impact in the field. In 2010, he was awarded a Marie Curie postdoctoral fellowship from the European Commission to join Marisa Carrasco's lab at New York University and, in the return phase, Eric Castet's lab in Marseille. In this project, they investigated relations between goal-directed hand and eye movements and perception; they revealed rapid changes in objective visual performance and subjective appearance during action planning. In October 2012, Rolfs started an independent research group (http://www.rolfslab.de) at the Humboldt University of Berlin and the Bernstein Center for Computational Neuroscience with core funding through the Emmy Noether programme of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation). Embedded in international collaborations (with colleagues in New York, Michigan, Paris, Sydney, Marseille, etc.), they assess the architecture and plasticity of perceptual processes in active vision, using eye tracking, motion tracking, psychophysics, computational modelling, EEG, and studies of clinical populations. Rolfs is the spokesman of the team organising ECVP 2017 — the 40th European Conference on Visual Perception — which attracted 1,200 vision scientists from 40 countries to Berlin.

Suddha SOURAV

Suddha Sourav studied Electrical and Electronic Engineering at Bangladesh University of Engineering and Technology. In 2011, he moved to Germany to pursue a master in Biomedical Engineering at RWTH Aachen University. His master thesis brought him to the Biological Psychology and Neuropsychology unit at the University of Hamburg, headed by Professor Dr Brigitte Roeder, which he joined as a PhD student in December 2013. His project focuses on visual development and multisensory interplay in humans, employing electrophysiological as well as behavioural methods. In parallel, he works as the lab manager.

Rebecca SUMALINI

Rebecca Sumalini received her Bachelor of Science in Optometry from Bausch & Lomb School of Optometry, affiliated to the Birla Institute of Technological Sciences (BITS), Pilani, India in 2009. Afterwards, she started working in the Institute for Vision Rehabilitation, L V Prasad Eye Institute. Her primary clinical and research interests include vision rehabilitation with a special focus on low vision evaluation and management of children with visual impairment and multiple disabilities.

Vidita VAIDYA

Vidita Vaidya received her undergraduate training in Life Science and Biochemistry at St. Xavier's College in Mumbai. She obtained her doctoral degree in Neuroscience at Yale University, and after postdoctoral fellowships at the Karolinska Institute and Oxford University, she returned to a faculty position at the Tata Institute of Fundamental Research, Mumbai in 2000, where she is currently a Professor. She has been a Senior Overseas Wellcome Trust Fellow and is a fellow of the Indian National Science Academy. She received the National Bioscientist Award in 2012 and the Shanti Swarup Bhatnagar Award in Medical Sciences in 2015. Her research group is interested in understanding the neurocircuitry of emotion, its modulation by life experience and the alterations in emotional neurocircuitry that underlie complex psychiatric disorders like depression.

Pavan K. VERKICHARLA

Pavan Verkicharla received his Bachelor's degree in Optometry from Bausch & Lomb School of Optometry, India and a PhD from the Queensland University of Technology (QUT), Australia (in the field of myopia and optics). He returned to India after gaining post-doctoral research work experience at the prestigious Singapore Eye Research Institute (SERI) with the intention of establishing India's first exclusive myopia lab at the L V Prasad Eye Institute in 2017. As a young researcher, Verkicharla continues his passion in myopia research and would like to invest more time understanding pathophysiology of myopia/pathologic myopia and develop anti-myopia strategies. He has several international peer-reviewed publications in the field of myopia and also serves as a reviewer for multiple optometry/ophthalmology journals.

Paul ZERR

Paul Zerr obtained a Bachelor's degree in Psychology from University of Groningen, the Netherlands in 2012 and a Research Master's degree in Cognitive Neuroscience from Utrecht University in 2015. He is currently working to obtain his PhD from Utrecht University, Helmholtz Institute, Department of Experimental Psychology under the supervision of Stefan Van der Stigchel. His main research interest lies in the interaction between saccade programming, visual working memory, and spatial attention. Further, he is interested in cognitive modelling, Bayesian statistics and mixed effects modelling. He has experience in eye tracking, EEG, brain computer interfacing, and transcranial electrical stimulation. Currently, Paul Zerr is investigating trans-saccadic pre-attentive sensory memory and its relation to attention and cognitive resources. Paul Zerr is chairman of the PhD Council of the Faculty of Behavioural and Social Sciences at Utrecht University. He obtained a VSS Elsevier/Vision Research Travel Award for Excellence in Vision Science in 2017.

Katharina ZINKE

Katharina Zinke is a Post-Doc at the Institute of Medical Psychology and Behavioural Neurobiology at the University of Tuebingen, Germany. She obtained a PhD in Developmental Psychology at the University of Dresden supervised by Prof Matthias Kliegel. Her PhD work mainly investigated the development and plasticity of cognitive functions over the whole life span. In 2012, Katharina Zinke joined the Institute in Tuebingen headed by Prof Jan Born. With her group at the children's sleep laboratory, she is currently investigating developmental aspects of sleep, memory and emotion. Katharina Zinke's research primarily focusses on the question of how sleep-dependent processes shape early cognitive development in infants and children.

The organisers INSA and Leopoldina kindly thank the L V Prasad Eye Institute for the conceptual and organisational support as well as for hosting the symposium. They also thank the German Research Foundation (DFG) for providing financial support of a number of junior fellows.

LVPEI
So that all may see

Contact INSA
Prof. Dr. Dorairajan Balasubramanian, FNA,
Director of Research Emeritus, L V Prasad Eye Institute
Kallam Anji Reddy Campus, L V Prasad Marg
Hyderabad-500034, Telangana, India
Phone: +91 (0)40 23 54 36 52
Email: dbala@lvpei.org

Contact Leopoldina
Dr. Ruth Narmann
Deputy Head International Relations Department
Jaegerberg 1, 06108 Halle (Saale), Germany
Phone: +49 (0)345 472 39 835
Email: ruth.narmann@leopoldina.org

German National Academy of Sciences Leopoldina

The German National Academy of Sciences Leopoldina brings together the expertise of some 1,500 distinguished scientists to bear on questions of social and political relevance, publishing unbiased and timely scientific opinions. The Leopoldina represents the German scientific community in international committees and pursues the advancement of science for the benefit of humankind and for a better future.

The Indian National Science Academy (INSA)

The Indian National Science Academy (INSA), established in 1935, is an apex body of Indian scientists representing all branches of science with the objectives of promoting science in India and harnessing scientific knowledge for the cause of humanity and national welfare, safeguarding interests of Indian scientists, establishing formal linkages with international bodies, promoting international collaborations and giving opinion on national issues after debate and discussions.

www.leopoldina.org
www.insaindia.org