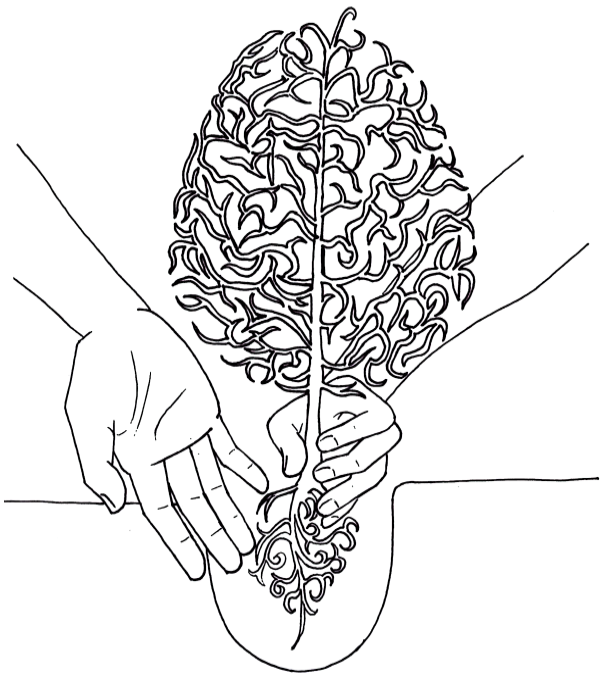
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

INSTITUTO DO CÉREBRO

HOUSE SYMPOSIUM 2017



THE NEW ICE AGE:
DECODING THE BRAIN

CAMPUS UFRN

NATAL

GREETINGS

We are happy to welcome you to the Third House Symposium of Instituto do Cérebro (ICe) of Universidade Federal do Rio Grande do Norte. This year, the symposium will be held at the Instituto Metrópole Digital (IMD), one of the latest UFRN institutes that are dedicated to developing new digital technologies and applying them to improve our understanding of nature's mysteries and to foster social development.

In fact, Ada Lovelace, the first computer programmer, once recognized that her analytical engine would have more applications than just calculations. Today, more than 150 years later, computers are everywhere and specifically used to understand one of the most complex structures of the universe – the brain. Thus, we hope this event will strengthen horizontal collaborations between computational scientists and neuroscientists, which is expressed in this year's theme: "The new ICe age: decoding the brain". It not only reflects our expectations towards 2018, when ICe will move to a new building within the Campus (next to IMD), but it also emphasizes our goals and ambitions for new explanations of brain function in health and disease.

The 3rd House Symposium will comprise 20 talks and more than 25 posters. These presentations includes the latest findings of ICe's research groups regarding cellular reprogramming, developmental consequences of congenital zika infection, synchronization of brain and body rhythms, visual and auditory function, experimental approaches to brain disorders and insights on learning and memory.

Finally, we would like to heartily thank IMD for hosting our meeting, our invited speakers (Marcos Gonzaga, César Rennó-Costa, Rodrigo Dalmoli and Stevens Rehen) for sharing with us their knowledge, ICe's students, staff and principal investigators for realizing this Neuroscience event. We also want to especially thank master student Elis Brisa dos Santos for her graphic designs for our symposium. Last but not least, we want to thank UFRN for its unconditional administrative support.

So please, join us in these two exciting days of science and fun at our future neighbor-building IMD.

The Organizing Committee

Venue: Instituto Metrópole Digital/UFRN, Auditório B205, Natal – RN
https://portal.imd.ufrn.br/

PROGRAM AT A GLANCE *

THURSDAY, NOVEMBER 30th		FRIDAY, DECEMBER 1st	
8:00 – 8:30	Registration and Welcome		
Topic 1 - Modeling neurological diseases in vivo and in vitro **Chair: Daiane Golbert**		**Topic 3 - Communication, navigation and memory** **Chair: Sergio Conde**	
08:30 – 09:00	Tarciso Velho	08:30 – 09:00	Cláudia Emanuele (MERCK)
09:00 – 09:30	Marcos Costa	09.00 – 09:30	Joseph Alves
09:30 - 10:00	Eduardo Sequerra	09:30 – 10:00	Adriano Tort
10:00 – 11:00	**Coffee & Poster Session 1**	10.00 - 11.00	**Coffee & Poster Session 2**
11:00 – 11:30	Marcos Gonzaga (IMT)	11.00 – 11:30	César Rennó-Costa (IMD)
11.30 – 12:00	Claudio Queiroz	11.30 – 12:00	Daniel Almeida
12.00 – 12:30	Rafael Bessa	12:00 – 12:30	Marina Pádua
12.30 - 14.00	***Lunch break***	12.30 - 14.00	***Lunch break***
Topic 2 – Manipulating neural activity **Chair: Lyvia Petiz**		**Topic 4 – System neuroscience** **Chair: João Bacelo**	
14.00 – 14:30	Rodrigo Dalmoli (IMD)	14.00 – 14:30	Kerstin Schmidt
14.30 – 15:00	Richardson Leão	14:30 – 15:00	Sergio Neuenschwander
15:00 – 15:30	Thawann Malfatti	15.00 - 16.00	**Coffee & Poster Session 2**
15.30 – 16:30	**Coffee & Poster Session 1**	16:00 – 17:00	Keynote Lecture: Stevens Rehen
16.30 – 17:00	Fernanda Palhano	17: 00 – 17:10	Closing remarks
17:00 – 17:30	Diego Sousa	17:10 – 18:00	*Short film session*
		18.00 - 22.00	Social event at Mahalila

* The Program at a Glance is subject to change.

IMT – Instituto de Medicina Tropical
IMD – Instituto Metrópole Digital

THURSDAY, NOVEMBER 30th, 2017

08:00 WELCOME AND INTRODUCTORY REMARKS
Sidarta Ribeiro (Director of the Brain Institute)

Topic 1 – Modeling neurological diseases in vivo and in vitro
Chair: Daiane Golbert

08:30 DISSECTING MICROCIRCUITS CONTROLLING VOCAL DEVELOPMENT AND PRODUCTION
Tarciso Velho

09:00 A NEURODEVELOPMENTAL APPROACH TO DISSECT MECHANISMS OF ZIKV CONGENITAL BRAIN INFECTION AND ITS CONSEQUENCES
Eduardo Sequerra

09:30 PROBING NEURONAL SPECIFICATION DURING DEVELOPMENT, ADULT NEUROGENESIS AND CELL LINEAGE REPROGRAMMING
Marcos Costa

10:00 – 11:00 Coffee & Poster Session 1 (P01 - P13)

11:00 GREEN FLUORESCENT PROTEIN EXPRESSING ZIKA VIRUS
Marcos Gonzaga dos Santos (IMT)

11:30 CEREBELLAR AND BRAINSTEM MALFORMATIONS ARE ASSOCIATED WITH EPILEPTIFORM PAROXYSMS IN PATIENTS WITH CONGENITAL ZIKA VIRUS SYNDROME
Claudio M Queiroz

12:00 TBA
Rafael Bessa

12:30 – 14:00 Lunch break

Topic 2 – Manipulating neural activity
Chair: Lyvia Petiz

14:00 EVOLUTIONARY ANALYSIS OF THE HUMAN NEUROTRANSMITTER GENE NETWORK
Rodrigo J.S. Dalmolin (IMD)

14:30 WHAT DID THE HIPPOCAMPUS SAY ABOUT THE RINGING EARS?
Richardson Leão

15:00 PHARMACOLOGICAL SUPPRESSION OF PHANTOM SOUNDS
Thawann Malfatti

15:30 – 16:30 Coffee & Poster Session 1 (P01 - P13)

16:30 ELETROENCEPHALOGRAPHY MARKERS OBSERVED DURING THE ACUTE EFFECTS OF AYAHUASCA AND ITS RELATIONSHIP WITH THE PSYCHEDELIC EXPERIENCE
Fernanda Palhano

17:00 BEHAVIORAL AND PHYSIOLOGICAL CORRELATES OF SOCIAL ANXIETY IN YOUNG MEN AND WOMEN
Diego Sousa

17:30 Social

FRIDAY, DECEMBER 1st, 2017

Topic 3 - Communication, navigation and memory
Chair: Sergio Conde

08:30 MERCK LECTURE
Cláudia Emanuele (MERCK)

09:00 RAT VOCALIZATIONS UNVEIL AN AUTONOMOUS WHISKING RHYTHM GENERATOR
Joseph Alves

09:30 CA1 SPEED CELLS ARE INTERNEURONS
Adriano Tort

10:00 – 11:00 Coffee & Poster Session 2 (P14 - P28)

11:00 PLACE AND GRID CELLS IN A LOOP
César Rennó-Costa (IMD)

11:30 IS THE RETROSPLENIAL CORTEX INVOLVED IN MEMORY CORTICALIZATION DURING SLEEP?
Daniel Almeida

12:00 ON THE ROLE OF THE PERIRHINAL CORTEX IN RECOGNITION MEMORY RECONSOLIDATION
Marina Pádua

12:30 – 14:00 Lunch break

Topic 4 – System neuroscience
Chair: João Bacelo

14:00 STRAIGHT LINES: PROCESSING CONTOURS OVER THE VISUAL MIDLINE
Kerstin Schmidt

14:30 ALL THAT GAMMA
Sergio Neuenschwander

15:00 – 16:00 Coffee & Poster Session 2 (P14 - P28)

Keynote Lecture I:

16:00 NEW INSIGHTS ABOUT BRAIN DEVELOPMENT USING STEM CELLS AND BRAIN ORGANOIDS
Stevens Rehen (UFRJ, IDOR)

17:10 Closing remarks
Organizing Committee

17:10 Short-film session featuring "O fim da história" by Richardson Leão

ORAL PRESENTATIONS

OR01 - DISSECTING MICROCIRCUITS CONTROLLING VOCAL DEVELOPMENT AND PRODUCTION

Tarciso Velho

Insights into the function of neural circuits that control human speech development can be gained by studying songbirds as a model organism. Songbirds serve as a useful model because song-development and speech acquisition share several features, including a critical period of vocal learning, the production of immature vocalizations (babbling and subsong), the requirement of intact hearing, the existence of social contingencies for normal learning, and a set of circuits dedicated for learning and production of vocalizations. Additionally, the small size and the fact that they breed well in captivity makes songbirds a tractable model for laboratory research. In the past few years, we have developed a series of tools that enable the manipulation of specific cell types within the brain areas controlling song learning and production, i.e. the song system. To determine the contribution of inhibitory neurons to vocal learning, we manipulated these cells during development. To investigate the role of excitatory and inhibitory cells to song production, we manipulated these two classes of cells independently during adulthood. Specifically, we have used a combination of acute and chronic genetic manipulations to hyper-activate or to silence individual neurons, coupled with extensive behavioral analysis of vocal signals. Our results support the idea that the ensemble rather than individual units (neurons) are fundamental to generate stable motor outputs. More importantly, our results show that inhibitory cells shape song development and continue to be essential for normal vocalizations during adulthood.

OR02 - PROBING NEURONAL SPECIFICATION DURING DEVELOPMENT, ADULT NEUROGENESIS AND CELL LINEAGE REPROGRAMMING

Marcos R. Costa

In this presentation, I will summarize the most recent findings of my laboratory that shed light on the understanding of cellular and molecular mechanisms supporting the generation of distinct neuronal types in the developing cerebral cortex, adult subventricular zone-olfactory bulb system and hippocampus, as well as somatic cell lineage reprogramming into induced neurons. I will also discuss recent evidence indicating that several molecular mechanisms of neuronal differentiation are conserved between primary and induced neurons. Lastly, I will discuss the significance of these observations towards the advance of reductionist models to study human neuropsychiatric disorders in vitro.

OR03 - A NEURODEVELOPMENTAL APPROACH TO DISSECT MECHANISMS OF ZIKV CONGENITAL BRAIN INFECTION AND ITS CONSEQUENCES

Eduardo Sequerra

Zika virus (ZIKV) congenital brain infection causes damages that lead to the formation of microcephaly. Understanding the mechanism through which ZIKV enters the brain can help the development of preventive strategies. In ZIKV-derived microcephalies, the prosencephalon is always malformed while the hindbrain gets damaged in a minority of cases. I hypothesize that the virus uses an anterior pathway for brain infection and that leads to a preference for anterior brain malformations. In this pathway, olfactory sensory neurons get infected through the amniotic liquid and transport the virus via their axons to the anterior brain. Our data shows that ZIKV injection in the amniotic fluid leads to olfactory epithelium (OE) and brain infection. To determine if ZIKV is

using the OE to enter the brain, we are adopting chemical and genetic strategies to kill this population and test if infection is prevented. A second question to explain the ontogenesis of the antero-posterior phenotype in these microcephalic children is what keeps the malformation in the prosencephalon in the majority of cases. My guess is that ZIKV brain infection triggers the maternal immunological system to react against developing brain antigens. This hypothesis includes the idea that while the autoimmune reaction helps inhibiting the viral spread beyond the anterior brain, it also damages it. To test it, we collected the serum from mothers of microcephalic patients and will isolate their antibodies. We will compare neural antigen recognition by antibodies from mothers of normal and malformed hindbrains. We will inject these antibodies in the brain of embryonic mice to test if they block developmental processes, such as cell division and migration. If we confirm that there is a maternal autoimmune component to the damage caused by ZIKV, then strategies to modulate immunological response should be considered to mitigate teratogenic effect of the infection.

OR04 - GREEN FLUORESCENT PROTEIN EXPRESSING ZIKA VIRUS

Marcos Gonzaga dos Santos (IMT)

Zika virus is a mosquito-borne positive sense single stranded RNA virus related to the dengue virus. The virus is divided in two main lineages, the Asian lineage, associated with neuropathies, including Guillain-Barré syndrome and microcephaly and the African lineage, which has not been associated to any neuropathy. In this talk, I will discuss strategies for obtaining a recombinant Zika virus that leads to the expression of the reporter gene GFP by the cells it infects. The GFP expressing virus could be used to easily track the infection both in vitro and in vivo. This recombination technique can also be used to generate chimera virus with selected segments from the Asian and African lineages, that can be used to determine which segments of the virus genome and proteins encoded within them are important for the neurotropism and consequent neuropathies.

OR05 - CEREBELLAR AND BRAINSTEM MALFORMATIONS ARE ASSOCIATED WITH EPILEPTIFORM PAROXYSMS IN PATIENTS WITH CONGENITAL ZIKA VIRUS SYNDROME

Claudio M Queiroz

Since the outbreak of microcephaly associated with congenital Zika virus infection in 2015-2016, most studies focused on the molecular identification of the disease, morphological alterations of relevant tissues and clinical manifestations of the syndrome. Despite many of them reported the occurrence of seizures and showed that epilepsy could be present in affected newborns; none correlated the pathological brain activity with morphological findings. Here, we describe the electrophysiological patterns associated with congenital ZIKV infection and its relation to morphological alterations. Of the 48 patients included in the study, 29 presented interictal spikes (28 unilateral and 22 bilateral) and 12 presented hypsarrhytmia. Surprisingly, sleep spindles, a biomarker of proper cortical development in infants, was absent in most patients. Interestingly, sleep spindles were present in patients with genetic microcephaly of similar age. We found that altered EEG patterns are associated with the occurrence of hindbrain malformations. The present study proposes that cases of microcephaly with significant cerebellar and brain stem malformations are indicative of future pathological brain activity. Further studies will be necessary to determine whether early antiepileptic treatment could prevent the development and expression of epileptic paroxysms and seizures.

OR06 - TBA
Rafael Bessa

OR07 - EVOLUTIONARY ANALYSIS OF THE HUMAN NEUROTRANSMITTER GENE NETWORK
Rodrigo SJ Dalmoli (IMD)

It has been proposed that the last common ancestor of all synapses emerged right before the Cnidarians. However, the presence of other synaptic elements (e.g. neurotransmitters) in a handful of taxa within eukaryotes raises the question of when the network of nervous system would be already established in evolution. Here, we searched for the origin of genes associated with the evolution of human synapses and their interaction for five major neurotransmitter systems (GABA, Glutamate, Serotonin, Dopamine, and Acetylcholine). We identified the evolutionary origin of each component of the gene/protein interaction network, searching for orthologs in 238 eukaryotes. Our results indicated that human neurotransmitter network have many genes rooted at the origin of eukaryotes and at the last common ancestor of Mammals and Cnidarian. Many genes in our set were already present in the common ancestral of all eukaryotes, but only Glutamatergic system is represented by essential receptors that emerged before the Porifera. Our results also suggest that genes emerging late in evolution of synapses are significantly more plastic and also expressed in derived brain tissues, like prefrontal cortex.

OR08 - WHAT DID THE HIPPOCAMPUS SAY ABOUT THE RINGING EARS?
Richardson Leão

Salicylate intoxication is a cause of tinnitus in humans and it is often used to produce tinnitus-like perception in animal models of the condition. Here we assess whether salicylate induces anxiety-like electrophysiological and behavioural signs. Using microwire electrode arrays, we recorded local field potential in the ventral and, in some experiments dorsal hippocampus, in an open field arena 1 hour after salicylate injection. We found that animals treated with salicylate moved dramatically less than saline treated animals. Treatment with the anxiolytic compound taurine reverted this effect. Salicylate-treated animals showed a strong 4-6Hz oscillation in the ventral hippocampus (with smaller peaks in dorsal hippocampus electrodes). Coherence in the 4-6Hz-theta band was low in the ventral and dorsal hippocampus when compared to movement-related theta coherence (7-10Hz). Our results suggest that salicylate-induced theta is mostly restricted to the ventral hippocampus. Slow theta has been classically associated to anxiety-like behaviours. Here we show that salicylate application can consistently generate type 2 theta in the ventral hippocampus. Future studies will show whether ventral hippocampus type 2 theta is caused by salicylate itself or by tinnitus perception.

OR09 - PHARMACOLOGICAL SUPPRESSION OF PHANTOM SOUNDS
Thawann Malfatti

Tinnitus refers to a phantom sound, usually high-pitched, in the absence of real auditory stimuli. This continuous perception of a repetitive sound makes individuals with tinnitus often show symptoms of stress, anxiety, irritability, altered focus of attention, insomnia and depression. The pathophysiology of tinnitus is still unknown, but the dorsal cochlear nucleus (DCN), a region known to integrate somatosensory and auditory stimuli, has been identified as a key structure for “triggering” tinnitus. To study mechanisms of tinnitus generation, we use viral vectors coupled with distinct

promoters to target sub-populations of neurons of the DCN. Here, Ca2+/Calmoduline Kinase II alpha (CaMKIIa) positive neurons are targeted for pharmacogenetic expression of Designer Receptors Exclusively Activated by Designer Drugs (DREADDs), more specifically inhibitory mutated human muscarinic receptors (hM4Di). These transmembrane receptors are activated when binding clozapine-N-oxide (CNO) that can be injected systemically to decrease cell excitability. To investigate tinnitus, we first pre-screened mice (C57Bl/6J) for normal hearing using behavioral test and auditory brainstem recordings. Next, one group was exposed to an Acoustic Noise Trauma (ANT, 2hr, 95 dBSPL 9-11kHz, n = 3) to induce tinnitus. A second group of animals was exposed to ANT under the effect of CNO (n = 3) to test if noise-induced tinnitus can be prevented by decreasing activity of CaMKIIa+ neurons. Of the three control groups (n = 3 per group), two of them were injected with viral vector contain only a fluorescent marker targeting neurons expressing CaMKIIa promoter in wild-type mice and also tested following CNO injections; and the third received the CaMKIIa-hM4Di viral injection, but went through ANT at 0dB (sham procedure). Preliminary results show that acute decrease of activity of CaMKIIa+ neurons of the DCN (n = 3 animals) can prevents tinnitus-like perception in a behavioral test. Moreover, decreasing activity of CaMKIIa+ DCN neurons during the ANT also prevent tinnitus-like perception using behavioral test (n = 3). Normal auditory brainstem responses were recorded for all animals (n = 6) to confirm that our tinnitus model does not lead to hearing loss. At the end of experiments animals were anesthetized for in vivo electrophysiological unit responses to sound, following saline or CNO injection (n = 4) and next sacrificed for histological procedures to confirm electrode placement. Preliminary analysis shows a variety of effects of CNO, with units decreasing evoked firing, increasing firing in response to sound (disinhibition), and units without altered response following saline or CNO injections. Further analysis will determine cell types, based of firing properties in response to sound, to decipher the neuronal circuitry affected by tinnitus. Still, our preliminary results suggest that an overall decreased activity of CaMKIIa+ neurons of the DCN can prevent tinnitus generation.

OR10 - ELETROENCEPHALOGRAPHY MARKERS OBSERVED DURING THE ACUTE EFFECTS OF AYAHUASCA AND ITS RELATIONSHIP WITH THE PSYCHEDELIC EXPERIENCE

Fernanda Palhano

Ayahuasca is a brew with psychedelic properties largely used by indigenous populations from the Amazon basin. It contains the psychedelic tryptamine N,N-dimethyltriptamine (DMT), and monoamine oxidase inhibitors (iMAO), such as harmine and harmaline. Ayahuasca is considered to be a serotonergic psychedelic, capable of inducing an altered state of consciousness with similarities to an oneiric experience, with intense alterations in perception, though, humor, emotion, and mystical-type experiences. The neural correlates of its acute effects have been investigated by different neuroimaging techniques, including electroencephalography (EEG). In this study, we explored EEG spectral changes in 48 healthy volunteers using a randomized double-blind placebo-controlled trial. Half of the volunteers received ayahuasca, half received placebo. We used an EEG system to monitor all volunteers throughout the dosing session, which lasted approximately 4-hours. Aiming to improve data quality, the volunteers were asked to perform two controlled tasks at three specific moments: before intake, 2h and 4h after intake. For the first task, they alternated moments of eyes open (20 seconds) with eyes closed (40 seconds) for 5 minutes, avoiding falling asleep. During the second task they should keep their eyes closed for another 5 minutes, again avoiding falling asleep. Spectral analysis at 2h after intake shows reduced alpha power, and increased theta and beta in the ayahuasca group with respect to the placebo, mainly in occipital and right temporoparietal regions. Correlation analysis revealed correspondences between the alpha power (2h) and individual scores on two scales used to measure psychedelic effects – the Hallucinogen Rating Scale (HRS) and the Mystical Experience

Questionnaire (MEQ). Additionally, we also present EEG traces with electrophysiological events that might be of importance for the representation of the psychedelic experience. Overall, our results suggest that the inhibition of alpha oscillations, increased theta and beta in right posterior brain regions play an important role on the psychedelic experience, maybe sharing mechanisms present during the oneiric experience.

OR11 - BEHAVIORAL AND PHYSIOLOGICAL CORRELATES OF SOCIAL ANXIETY IN YOUNG MEN AND WOMEN

Diego Sousa

Social Anxiety Disorder (SAD) has a high prevalence in contemporary society. Currently, psychological and psychiatric diagnoses are based only on verbal contents and clinical observation, and DSM-5 still uses this information. The aims of this study were to search for behavioral and physiological markers that might improve the diagnosis of SAD. Additionally, we examined possible sex differences in the symptoms expression and possible biological differences between Generalized Social Anxiety and Specific Social Anxiety (performance only – a specify at DSM-5). To investigate these questions, young men and women between 18 – 30 years old were recruited at the psychology school Clinic Service (UnP – Universidade Potiguar) to participate in two consecutive trials: Trial 1 – participation in the behavior group therapy (BGT), once a week, during 12 weeks. Sessions' duration ranges from 120-150 minutes, and in all participants, we measured situational anxiety and social anxiety by questionnaires, and the performance during a reading task in the first, sixth and twelfth weeks during the BGT. Preliminary results for anxiety did not show any effect of sex, but an increasing effect on the decreasing symptomatology associated with cumulative sessions was found. Trial 2 – after BGT, all participants who complete successfully the majority of sessions, and show improvement in the symptomatology were invited to be engaged for the experimental protocol of Trier Social Stress Test (TSST). Along with the TSST, situational anxiety, heart rate variability (HRV) and salivary cortisol were sampled three times: (1) just before the discourse, (2) 20 minutes, and 50 minutes (recovery) after. The analysis of these additional data, as well as the examination of the records of the voice and image during both TSST and reading task, are expected to better characterize possible social anxiety biological markers.

OR12 - MERCK LECTURE

Claudia Emanuele (MERCK)

Predictive neural models have its challenges given the brain complexity, comprised of many diverse cell types, complex cell-to-cell interactions and intricate signaling pathways. Merck has elected Neuroscience as a key area to develop innovation and offer new breakthroughs using molecular tools and stem cell models to mimic the physiology of the brain and helping to explore the origins of neurological disorders and diseases. We can provide tools to create the genetic model of your design, any modification, any target, any cell type – our CDS (Cell Design Studio) has unmatched expertise in cell line engineering capabilities. We offer some of the most highly published cell type marker antibodies like for NeuN, and the most trusted source of bioactive small molecules. We are the leader in immunoassays from western blot, protein- protein interaction, ELISA, multiplex and now the new sensitive single analyte detection. In this opportunity, we will give a brief overview of Merck comprehensive portfolio of Neuroscience solutions for acquiring or creating cellular and genetic models, cellular characterization and identification, and tracking protein biomarkers.

OR13 - RAT VOCALIZATIONS UNVEIL AN AUTONOMOUS WHISKING RHYTHM GENERATOR

Joseph Alves

Rats actively explore the environment through the sensorimotor rhythms of whisking and sniffing. Whisking, the rapid cyclic movement of the facial vibrissae, provides a rich tactile picture of their peripersonal space, while sniffing allows the rats to sample the olfactory space with high temporal resolution. It is well established that these two rhythms are tightly linked, as they not only share muscular structures but also are synchronized during exploratory events, suggesting the prevalence of an oscillatory connection between both behaviors at the neural level. It has been suggested that the inspiratory rhythm serves as a master clock, to which the whisking is enslaved. However, because of their tight synchrony, it is difficult to evaluate whether brainstem whisking nuclei are also able to generate rhythms independent of respiration. Past studies have shown that the emission of ultrasonic vocalizations, prominent in rat social interactions, causes a natural interruption in the respiratory rhythm by extending the duration of the exhalation phase. In this work, we investigate the effects of this disruption on the temporal relation between whisking and sniffing. We monitored facial interactions between pairs of rats located in opposite platforms separated by a gap. We simultaneously recorded electromyography from the vibrissae muscles, intranasal pressure for measuring the respiratory cycle and ultrasonic vocalizations in animals in free social exploration. Our results show that during the emission of vocalizations the canonical synchronization of whisking to sniffing is lost, and the vibrissae follow an independent faster oscillation. This suggests that the whisking circuits are able of generating an endogenous rhythm independent of respiration.

OR14 -CA1 SPEED CELLS ARE INTERNEURONS

Adriano Tort

Spatial navigation relies on visual landmarks as well as on self-motion information. In familiar environments, both place and grid cells maintain their firing fields in the darkness, suggesting that they continuously receive information about locomotion speed required for path integration. Consistently, “speed cells” – neurons whose firing rate correlates with speed – have been recently described in the medial entorhinal cortex. Here we investigate whether a similar speed signal is present in the dorsal hippocampus. We show that CA1 has speed cells that are context-invariant and stable across space and time. Moreover, their speed-correlated firing occurs within theta cycles, independently of theta frequency. Interestingly, a physiological classification of cell types reveals that all CA1 speed cells are inhibitory. In fact, while speed modulates pyramidal cell activity, only the firing rate of interneurons can accurately predict locomotion speed on a sub-second time scale. These findings shed new light on network models of navigation.

OR15 -PLACE AND GRID CELLS IN A LOOP

César Rennó-Costa (IMD)

Place and grid cells are neurons found in the hippocampus that encode the position of the animal and, for that, are thought to be the neuronal substrate of a cognitive map in the brain. In this talk I’ll discuss the implication of having place and grid cells organised in a loop, as the available anatomical evidences indicate. Based on the results of simulations using a computational model, we will explain observations of many experimental works and propose a theory on how the hippocampus encodes the surrounding environment.

OR16 - IS THE RETROSPLENIAL CORTEX INVOLVED IN MEMORY CORTICALIZATION DURING SLEEP?

Daniel Almeida

Hippocampal dependent memory, like declarative memory in humans and contextual memory in rodents, is known to disengage from the Hippocampus (HPC) across time. By a process called Memory Corticalization, multiple cortical structures get progressively involved in retrieving the memory trace, with a special protagonism for the Prefrontal Cortex (PFC) and the involvement of the Restrosplenial Cortex (RSC). For the last 20 years, our lab has implicated sleep as a critical behavioral state supporting this process, along with growing independent evidence produced by multiple labs. Although important advances have been unveiling the HPC and PFC roles in memory formation and corticalization, the involvement of the RSC in these processes is not yet clear. Recent molecular evidence has suggested that the RSC is more active during Rapid-Eye-Movement (REM) Sleep than any other behavioral state. We recorded electrophysiological data from these memory related core regions in rats across naturalistic behavioral states transitions and corroborated the molecular results. We showed that RSC cells fire preferentially during REM sleep and that REM sleep fast gamma (100 – 160 Hz) oscillations in the RSC are modulated by the phase of the ongoing HPC theta rhythm. By recording electrophysiological data from these memory related core regions of rats before and after contextual fear conditioning and retrieval, we intend to assess if this RSC increased activation during REM sleep is related to the process of memory corticalization.

OR17 - ON THE ROLE OF THE PERIRHINAL CORTEX IN RECOGNITION MEMORY RECONSOLIDATION

Marina Pádua

Consolidated memories can become labile when reactivated and must undergo a protein synthesis-dependent restabilization process called reconsolidation to persist. Object recognition memory (ORM) confers the ability to discriminate familiar from novel objects. The perirhinal cortex (PER) is in a pivotal anatomical position to regulate the flow of information among memory-related brain areas but, although it has been implicated in ORM reconsolidation, its actual role in this process remains controversial. We found that intra-PER infusions of the protein synthesis inhibitor anisomycin caused amnesia when administered immediately after ORM reactivation in the presence of just one familiar object, but not when reactivation occurred in the presence of one new object, two familiar objects, or a familiar object alongside a new object. Our results suggest that PER involvement in ORM reconsolidation depends on the very specific set of conditions entailing the physical absence of a familiar stimuli object during reactivation. Currently, we are using optogenetics and extracellular in vivo recordings to investigate the molecular and electrophysiological mechanisms underlying the retrieval-induced modification of the recognition memory trace.

OR18 - STRAIGHT LINES: PROCESSING CONTOURS OVER THE VISUAL MIDLINE

Kerstin E. Schmidt

Morphological and functional homologies between the lateral intrinsic and callosal network in early visual areas are discussed. Both networks selectively link distributed neuronal groups with similar response properties and the actions exerted by callosal input reflect the functional topography of those networks. Reversible deactivation studies in cats strongly support that close to the vertical meridian representation callosal networks perpetuate intrinsic networks. Electrophysiological recordings and voltage-sensitive dye imaging evidence demonstrate that both stimulus-driven and spontaneous activity of neurons that prefer potentially “midline crossing” features

receive stronger influence by contralateral input. In particular, callosal connections seem to facilitate perceptual grouping along potential motion or (shape) trajectories crossing the visual field's midline before a stimulus arrives. We propose that in cats, feature-selective lateral connections in general might exhibit a "cardinal bias" to interconnect neurons preferring vertical and horizontal contours. Those connections could support a spontaneously active network which pre-activates neurons along motion or shape trajectories frequently occurring in daily vision. Indeed, statistical properties of natural scenes as viewed by cats exhibit a bias for cardinal contours, and among these, an additional prevalence for horizontal contours. We compare the cardinal bias of cats to other orientation selectivity biases in rodents and birds.

OR19 -ALL THAT GAMMA

Sergio Neuenschwander

Gamma cortical rhythms have been implicated in visual binding and attention. So far, most evidence in support of this hypothesis is based on studies that used simplified stimuli, such as gratings and bars. More naturalistic approaches led to diverging conclusions. In humans required to hold fixation, ECoG responses in early visual cortex showed gamma for gratings but not for images. On the contrary, in macaque monkeys, ECoG signals revealed strong gamma during free-viewing of natural scenes. To clarify these issues, here we analyze gamma spike-field coherence in V1 responses of capuchin monkeys with a paradigm that allows direct comparisons between fixation vs. free viewing conditions and gratings vs. natural stimuli. We show that gamma is characteristically strong for optimally oriented gratings regardless of viewing condition. Gamma is surprisingly absent, however, during free viewing of natural images and movies. Similar negative results were also obtained when the monkeys were exposed to real-world scenes. These new findings in a new-world monkey weaken the notion that gamma is necessary for visual processing in natural conditions.

KEYNOTE LECTURE

NEW INSIGHTS ABOUT BRAIN DEVELOPMENT USING STEM CELLS AND BRAIN ORGANOIDS

Stevens Rehen

D'Or Institute for Research and Education (IDOR) & Institute of Biomedical Sciences, Federal University of Rio de Janeiro, Brazil

Progress has been made regarding the differentiation of human pluripotent stem cells into neural stem cells and astrocytes in 2D and also in 3D cultures, such as cerebral organoids. These organoids recreate some steps of the cerebral cortex development, showing potential for human modeling studies. These models offer an exciting new range of opportunities to investigate the biology of virus infection, cell signaling triggered by psychedelics and brain development. Our recent results will be discussed during this presentation.

POSTER SESSION 1 (THRUSDAY)

P01 - REPROGRAMMING OF DIFFERENT CELL TYPES INTO NEURONS THROUGH A COCKTAIL OF SMALL MOLECULES

Ana Raquel M. Farias, Marcos Romualdo Costa

Recently, many techniques have been described to generate neurons that could be used in cell- based therapies to neurodegenerative diseases or acute central nervous system injuries. One of such techniques is the lineage reprogramming of differentiated cells into neurons, either directly or indirectly. However, most protocols for lineage reprogramming rely on the expression of ectopic genes, which could lead to other unexpected transcriptional changes in the reprogrammed cells. To circumvent this possibility, we here evaluate the possibility to reprogram different cellular types – astrocytes from mouse cortex and mesenchymal stem-cells isolated from human umbilical cord (hUCMSC)- into neurons through the use of a cocktail of small molecules in the cell culture medium. This cocktail contains molecules associated with different cellular pathways, including gene expression regulation, neurogenesis modulation and cell cycle control, and it has been previously shown to reprogram fibroblastos into neurons. To assess the cellular phenotype after treatment of astrocytes and hUCMSC cultures with small molecules, we evaluated the expression of neuron- specific proteins, morphology and gene expression by immunocytochemistry and RT-qPCR. Our preliminar data show that astrocytes and, to a lower extent, hUCMSC adopt morphologies and gene expression compatible with a neuronal phenotype, indicating that small molecules can be used to reprogram those cell populations.

Keywords: neuronal reprogramming; small molecules; astrocytes; mesenchymal stem cells; neuronal differentiation.

P02 - CELL LINEAGE PROGRESSION IN THE ADULT HIPPOCAMPUS REVISITED: EVIDENCE OF PROGENITOR TRANSDIFFERENTIATION

Daniela M.S. Moura, Claudio M. Queiroz, Marcos R. Costa

Brain Institute, UFRN, Brazil

Cell lineage in the adult hippocampus comprises multipotent (Type 1 and 2a) and neuron-determined (Type 2b and 3) progenitors. The current model assumes that multipotent stem cells generate neuron-determined intermediate progenitors that become post-mitotic neurons in a unidirectional way. In the present work, we fate-mapped neuronal progenitors using Dcx-CreERT2 and CAG-CAT-EGFP double-transgenic mice, hereafter referred to as cDCX/EGFP. We show that three days after tamoxifen-mediated recombination in cDCX/EGFP adult mice, virtually all GFP+ cells in the dentate gyrus co-expresses DCX. However, within 30 days, about 15% of GFP+ cells become GFAP+ astrocytes. These data suggest that Type 2b/3 DCX+ progenitors either retain the capacity to generate astrocytes or can regress to more primitive stages (Type 2a or 1). To evaluate these possibilities, we boosted neurogenesis in the dentate gyrus by local administration of epileptogenic drugs. Intrahippocampal injection of kainic acid (KA) led to a significant increase in the number of GFP+ cells in both ipsi and contralateral dentate gyrus. Remarkably, in the ipsilateral dentate gyrus, most GFP+ cells adopted glial morphologies and expressed the astrocytic protein GFAP. Conversely, on the contralateral side, GFP+ cells differentiated mainly into granular neurons. Intriguingly, at early time-points after recombination, we observed a small number of unexpected labeled cells displaying radial-glia morphology, a hallmark of Type 1 multipotent progenitors, suggesting that some type2b progenitors transdifferentiated. Intrahippocampal injection of pilocarpine also leads to an important increase in the number of GFP+ cells in both ipsi and contralateral dentate gyrus, but the vast majority of cells differentiate into neurons. Importantly, both drugs were able to bilaterally elicit paroxysms, high-amplitude discharges and seizures. Altogether, these results indicate that Type 2b/3 progenitors are not restricted to the generation of neurons, but rather retain bi-potency and/or the ability to return to more primitive stages in the

lineage and generate astrocytes. Under basal conditions, generation of astrocytes represents a small fraction of newly generated cells in the adult hippocampus, but under pathological conditions, this proportion can be massively altered. Finally, these observations also suggest that the drug used to model temporal lobe epilepsy differentially affects cell lineage progression in the adult hippocampus.

P03 - EVIDENCE FOR PROGENITOR CELL REPROGRAMMING IN THE DEVELOPING CEREBRAL CORTEX FOLLOWING SELECTIVE NEURONAL ABLATION

Bruna Landeira (together with Jéssica Araújo and Marcos Costa)

The cerebral cortex of mammals is histologically organized in separate layers of excitatory neurons that have distinct patterns of connections with cortical or subcortical targets. During development, these cortical layers are sequentially established through an intricate combination of neuronal specification and migration in a radial pattern known as “inside-out”: deep-layer neurons are generated prior to upper-layer neurons. Notably, there is a good correlation among the generation time, laminar position, expression of specific transcription factors and hodological features of neurons: i) Layer VI, TBR1+ corticothalamic neurons (CTN); ii) Layer V, CTIP2+ corticofugal neurons (CFN); iii) Layer IV, RORb+ stellate neurons; and iv) Mostly layers II, III and V, SATB2+ cortico-callosal neurons (CCN). However, it remains largely unclear whether early-generated neurons could influence the generation of subsequent neuronal cohorts. To tackle this important question, we induced the selective cell death of early-generated CTN and CFN and fate-mapped the neuronal population generated after ablation. We observed that 24h after ablation, progenitor cells, which are usually committed to generate stellate neurons and CCN, resumed the generation of CTN expressing the transcription factor TBR1. Interestingly, many of these TBR1-positive neurons settled ectopically within layers II and III, as expected for CCN neurons generated at the same stage, suggesting that migration of post-mitotic neurons is independent of cell-type specification. Furthermore, we observed that CTN and CFN ablation at the embryonic stage leads to a disorganization in the distribution of CCN in the primary somatosensory area of adult animals, indicating that early-generated neurons control important aspects of CCN generation and differentiation. Using in vitro assays to further interrogate the mechanisms of progenitor cell re-specification following neuronal ablation, we found that only neuronal ablation in situ was capable of inducing the de novo generation of CTN. Moreover, we also observed that cell-cell communication plays an important role in the acquisition of unique neuronal phenotypes. Together, our data indicate the existence of feedback signals from early-generated neurons to progenitor cells and immature neurons controlling the generation of CCN.

P04 - ACTION OF ACUTE AND CHRONICLE ELECTRIC STIMULATION OVER NEURONAL TYPE SPECIFICATION OF ADULT SUBVENTRICULAR ZONE PROGENITORS

Carvalho BS; Cunha-Pereira C; Moura DMS; Sequerra EB; Costa MR

The Subventricular zone (SVZ) is the site of adult neurogenesis to the olfactory bulb (OB). SVZ progenitors generate mainly two types of interneurons that integrate in the OB: granular and periglomerular (PG) neurons. These cells can also be further subdivided based on the expression of the proteins calbindin, calretinin or tyrosine hydroxylase. The mechanisms that lead to the specification into these neuronal types are unknown. In the spinal cord neurogenesis, neurotransmitter identity is specified according to early spontaneous electrical activity in progenitor and precursor cells. This electrical pattern guide master transcription factors expression and the differentiation in a particular subtype. Manipulation of electrical activity can change de fate of progenitors and derived neurons. We hypothesize that the specification of SVZ-OB interneurons could also be influenced by electrical activity. To test this hypothesis,

two experiments were designed to manipulate the cell electricity either acutely or chronicly. First, DCX-Cre-ER2/lox-GFP mice were injected with Kainic Acid (KA) or PBS in the neuroblasts migratory route to the bulb. Tamoxifen was injected 4 days after to label immature neuroblasts affected by KA and perfusion was performed 45 days after KA injection. In a second set of experiments, wild type mice were injected with a retrovirus containing the RNA for the expression of NaChBac, a bacterial sodium channel that increases electric activity. This channel is fused with the GFP that labels the infected cells. To control this experiment, a mutated non-functional version of the NaChBac channel was used. Cell identity was analyzed 45days after injection. Our preliminary results suggest that the neuroblasts stimulated by the acute approach differentiate into TH+ PG neurons at the expense of Calbindin+ PG phenotype.

P05 - THE OLFACTORY EPITHELIUM AS A POSSIBLE PATHWAY FOR ZIKA VIRUS ENTRANCE IN THE MOUSE BRAIN

Rocha AKAA, Landeira BS, Custódio JLM, Sequerra EB

Brain Institute, Federal University of Rio Grande do Norte

Central nervous system (CNS) malformations related to Zika Virus (ZIKV) infection more often affect anterior structures, such as the cortex and the basal ganglia, whereas more caudal structures such as the cerebellum and brainstem are only affected in the most severe cases. There are some possible phenomena that can explain this effect, like viral tropism for anterior brain or anterior source for brain entrance in the brain. It is known that the amniotic liquid gets infected in pregnancies of ZIKV-derived microcephalies. Therefore, we hypothesized that the antero-posterior pattern found in human malformations derived from ZIKV is due to the entry of the virus through the embryonic olfactory system, which is in direct contact with the amniotic liquid. Objective: The aim of this project is to verify whether the ablation of the olfactory epithelium (OE), damaged by injection of zinc sulfate in the nostrils of post-natal mice, would prevent the virus entrance into the brain. In addition, we want to investigate the pattern of infection of the virus along the antero-posterior (A-P) axis of the CNS by identifying the cell types most affected by the Zika Virus. Methods: Animal experimentation use is approved by the Ethics Committee in Animal Experimentation of Universidade Federal do Rio Grande do Norte (UFRN), project number 004/2016. Mice colony is maintained at the Brain Institute, UFRN. We are using an isolated ZIKV lineage in Pernambuco in the year 2015. The pattern of ZIKV infection along the A-P axis is being characterized after injection in the amniotic liquid of E12 mice. We are using postnatal day 3 (P3) mice for the OE ablation assay. For ablating the OE, zinc sulfate solution (0.17M) is injected into the nostrils (approximately 5ml). At P4, we are injecting ZIKV into the nasal route. Control animals receive saline instead of $ZnSO_4$. Immunohistochemistry is performed with 4G2 antibody, which recognizes the envelope protein of flaviviruses. We are co-localizing this antibody with cell type-specific markers in coronal or sagittal whole head slices to preserve the olfactory pathway to the olfactory bulb. The infection of other brain regions, like the cerebral cortex, cerebellum and brainstem will be tested. Partial results and Conclusions: Our preliminary data demonstrates that ZIKV infects the OE and the brain after injection in the amniotic liquid in at least 6 days but not earlier than 24 hours. The percentage of these cells that are postmitotic young neurons (Dcx+) in the OE is under 20 while in the olfactory bulb and cortical plate is about 50. These results suggest that the OE is a possible pathway for ZIKV embryonic brain infection. For testing that, we are developing a model of postnatal ZIKV infection through nose injections. Six days after injection in the P3 nostril, ZIKV is expressed in the olfactory epithelium of 50% and not in the brain (with the exception of few cells in the olfactory bulb of one animal). We observed ZIKV infected cells in the cerebral cortex and hippocampus of one animal 8 dpi. Although preliminary, these data suggests that the postnatal olfactory system is also susceptible for ZIKV and can be used in OE ablation experiments. Keywords: Zika Virus, Olfactory Epithelium, Brain Malformations

P06 - MORPHOLOGICAL AND ELECTROPHYSIOLOGICAL ALTERATIONS IN POSTNATAL NEWBORN NEURONS CAUSED BY ZIKA VIRUS

Jessica Winne*, Lyvia Lintzmaier Petiz*, Eduardo Sequerra & Richardson N Leao *
Equal contribution

The Zika Virus (ZIKV) infects neural progenitor cells (NPCs) causing disruption of cell differentiation and subsequently cell death. The TYRO3-AXL-MERTK (TAM) receptors are hypothesized to be the key for the neurotropism of ZIKV. While TAM receptors are expressed in both embryonic and adult neural progenitor cells, most studies involving neural ZIKV infection have focused on embryonic stages. In the present study we investigated the consequences of ZIKV infection on postnatal neurogenesis and neuronal differentiation. In order to assess neuronal development and differentiation, we performed patch-clamp recordings targeting doublecortin (DCX) expressing cells (newborn neurons) in the Dentate Gyrus of DCX-cre/GFP mice previously infected with ZIKV or mock virus (intracerebral injection). Tamoxifen was used to trigger GFP expression in DCX neurons 14 days before the experiment. After patch clamp recordings, the cell nucleus was extracted for performing single-cell reverse transcripitase PCR to identify if the cells were infected with ZIKV. Initial results indicate that DCX expressing neurons infected with ZIKV display changes in action potentials firing frequency, which may be involved with modifications in Na+ and K+ channel expression, besides changes in passive properties (input resistance and capacitance). These results suggest that ZIKV infected postnatal neural progenitors and altered intrinsic properties of the newborn cells what may can cause cognitive abnormalities after infection.

P07 - RECORDING AND ANALYSIS OF ELECTROGRAPHICAL ACTIVITY IN MICROCEPHALIC CHILDREN IN AN OUTPATIENT CLINIC

Antonio Jhones Rocha, Eduardo B Sequerra, Claudia S Maia, Nívia Arraes, Áurea N Melo, George Nascimento, Claudio M Queiroz

Neural Netwroks and Epilepsy Lab, Brain Institute

Knowledge about the physiopathology of epilepsies arises from the capacity of recording brain's electrical activity during and in between seizures. Electroencephalography (EEG) is the technique responsible for determining which brain areas are responsible for the generation, propagation, and termination of ictal activity (i.e., seizures). It is also essential for the confirmation of the diagnosis of epilepsy and its type. In the present work, we developed, improved and validated two set-ups of electrophysiological recordings. The first, developed in the Brain Institute, allowed the acquisition, visualization, and storage of epilepticform activity in experimental animals. The second set-up, developed earlier in the Brain Institute to assist the teaching of electrophysiology for UFRN's undergraduates, was used to record electrical activity from children with microcephaly due to congenital infection with the Zika virus in the hospital outpatient clinic. The results presented here focus on the second type of recordings because of its social and public health relevance in our region. We believe that the translational applications of the project developed here can bring improvements in the care and treatment of individuals suffering from disorders associated with pathological electrical activities of the nervous system, such as epilepsy.

Key words: EEG; microcephaly; zika; epilepsy

P08 - INTRAHIPPOCAMPAL ADMINISTRATION OF PILOCARPINE IN MICE AS A NEW MODEL OF TEMPORAL LOBE EPILEPSY

Caroline Pereira de Araújo*, Igor Rafael Praxedes de Sales*, Aryel Nayara dos Santos and Claudio Marcos Queiroz

Animal models have contributed significantly to our understanding of the pathophysiology of temporal lobe epilepsy (TLE). The "epileptic condition" is obtained after a long-lasting status epilepticus (SE) induced by systemic administration of chemoconvulsants, even though systemic administration of pilocarpine or kainic acid may lead to multiple epileptic foci which add variability in the observations regarding seizure statistics. Also, systemic pilocarpine administration has been associated with high mortality rate while local application of kainic acid yields generalized cell death and low prevalence of spontaneous seizures. Here, we describe the behavioral and electrophysiological effects of local application of pilocarpine (4 doses of 700 µg/µL solution: 70 µg/site, 245 µg/site, 400 µg/site and 700 µg/site) in the mouse hippocampus during isoflurane anesthesia. Pilocarpine caused a long- lasting and dose-dependent SE (animals with SE: saline: 0/16; 70 µg/site: 3/12; 245 µg/site: 4/4; 400 µg/site: 5/5 and 700 µg/site, 21/21). Mice receiving high doses of pilocarpine (400 and 700 µg/site) showed reduced latency to movement (0.8 0.5-0.9 $p<0.05$; 1.0 0.4–6.0 minutes $p<0.001$, results expressed as median minimum-maximum values, Kruskal-Wallis followed by Dunn's test) after termination of isoflurane anesthesia in comparison with saline-treated mice (9.5 1.4-20.0 min). Similarly, animals treated with high doses of pilocarpine (400 and 700 µg/site) presented decreased seizure latency (0.6 0.5-1.5; 1.1 0.4–6.0 min $p<0.05$, Kruskal-Wallis followed by Dunn's test) and increased seizure severity (Racine class: 5 – 100%) in comparison with animals treated with low doses (70 and 245 µg/site). Animals receiving saline did not display behavioral SE or seizures. However, all animals lost weight after the surgical procedure for local administration (including saline-treated animals), but again, the weight loss was dose-dependent. Interestingly, none of the animals treated with pilocarpine (n = 42) presented tonic seizures and the death rate was lower in comparison with systemically treated animals (n = 10/11). In behavioral task performed with control and chronically epileptic animals, pilocarpine-treated mice exhibit small retarded acquisition of learning and memory in comparison with kainate-treated mice. Preliminary electrophysiological analysis showed the occurrence of interictal spikes, some of these with high frequency oscillations in the animals treated with pilorcapine. Together, these data suggest that intrahippocampal administration of pilocarpine in mice can be a good and reliable experimental model of TLE. The advantages include (i) the easiness of the experimental procedure, (ii) reduced mortality, (iii) localized epileptic focus and (iv) reduced variability.

P09 - CHARACTERIZATION OF CELL TYPES AFFECTED BY NOISE-INDUCED TINNITUS IN THE AUDITORY CORTEX OF MICE

Ingrid Nougeira, Thawann Malfatti & Katarina Leao

Tinnitus is an abnormal state of nerve cell activity of the auditory system, leading to perception of 'phantom' sounds. It can be acute, lasting hours or days, or chronically perceived. Although this continuous perception of sound is not harmful per se, it can lead to severe psychological stress, insomnia and depression. Several studies indicate the auditory cortex as a potential target for transmagnetical stimulation to alleviate tinnitus perception yet little is known of how tinnitus alters cortical circuits. Here we will investigate cellular populations of the auditory cortex in a mouse model of noise-induced tinnitus that does not generate hearing loss (preliminary data, T Malfatti). Our goal is to identify the tonotopic frequency region of the auditory cortex that is affected by a noise-trauma (8-12kHz, 90dB, 2 hrs) using an activity-activated calcium integrator (CaMPARI). The CaMPARI is a fluorescent protein that photoconverts from green to red when stimulated by violet light (~400nm) during influx of calcium. Adeno-associated virus (AAV5/9-hSyn-CaMPARI) will be injected into the primary auditory cortex (A1) at several depths, to identify regions acutely activated by the noise-trauma, of 3-4 week old wild type mice. Approximately 2-3 weeks after the injection, mice will be subjected to the noise trauma while optically stimulated with violet light into the auditory cortex. Thereafter animals will be immediately sacrificed, the brains dissected and sliced (300µm) and 1) mounted for fluorescent microscopy, or 2) used for whole cell patch

clamp recordings to characterize cell types affected and potential hyper excitability in activated (red) cells. These results will be a first step to identify neurons affected by acoustic trauma and will allow us to map regions of the A1 affected by tinnitus generating noise. To understand the cellular mechanisms of tinnitus is crucial for better treatments of tinnitus using cortical stimulation.

P10 - SOCIAL BEHAVIOR INHERITANCE AND CORTICAL INTERNEURON DISTRIBUTION IN THE DESCENDANTS OF THE VPA MODEL OF AUTISM

Brandão, J.A., Araujo-Sousa, C., Fernandes, P.B., Soares, A. M. A., Costa, M.R. and Romcy-Pereira, R.N.

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Autism refers to a heterogeneous group of neurodevelopmental disorders that affects the brain maturation and produces sensorial, motor, language and social interaction deficits in early childhood. Studies indicate an important involvement of genetic factors predisposing the expression of autistic symptoms, as well as environmental factors during embryonic and postnatal life. Recent researches in animal models indicate that changes during neurodevelopment can produce modifications in neuronal maturation pattern and hyper-excitable circuitry, resulting in the typical symptoms of autistic patients. Previous data from our lab validated the animal model induced by VPA exhibited clear autistic-like behavioral abnormalities such as hyperlocomotion, prolonged stereotyped behavior and reduced social interaction, and decrease in the number of parvalbumin-positive interneurons in the anterior cingulate cortex and in the prelimbic cortex of the mPFC. Therefore, the aim of this work is to evaluate the occurrence of behavioral inheritance in animals born to parents exposed to VPA during the prenatal period (F2) in behavioral tasks exploratory, cognitive and social character and the influence of cross fostering in this parameters. We also evaluated the distribution of inhibitory neurons in the prefrontal cortex in the F2 generation. Our results show that F2 generation animals demonstrated hyperlocomotion followed by reduction of stereotyped behavior. The social deficit persisted in descending offspring. It is interesting to note that the cellular quantification revealed an increase of parvalbumin cells in mPFC, suggesting an excitatory/inhibitory unbalance that persists in a different way. Cross fostering revealed that the presence of an adoptive mother for parental care of the F2 treated animals was not able to revert the social interaction deficit, showing that the inheritance of this trait is not related to postnatal maternal care, but due to genetic inheritance. Altogether, our results indicate that the VPA model in rats is a powerful tool to study the cellular mechanisms leading to circuit alterations and its correlations with behavioral deficits observed in autism. We also evidence that social behavior induced by VPA prenatal exposure can be inherited by next generation. We hope that our results may contribute to the greater understanding of the limbic-cortical cell changes and mechanisms of epigenetic inheritance behavior presented in this model, as well as clarify its functional implications.

Keywords: autism, VPA, social behavior, parvalbumin, epigenetic inherance

P11 - STRUCTURAL DIFFERENCES OF REM AND N2 DREAM REPORTS ASSESSED BY SPEECH GRAPH ANALYSIS

Joshua M. Martin, Danyal Wainstein, Natalia B. Mota, Sérgio A. Mota-Rolim, Mark Solms, John Fontenele Araújo, Sidarta Ribeiro

The extent to which rapid eye movement sleep (REM) mentation may differ from that of non-REM mentation remains an important line of enquiry for contemporary dream research. Previous studies have found that dream reports collected after awakenings from REM are, on average, longer, more vivid, bizarre and story-like compared to dream reports collected from non-REM. Despite such findings, a quantitative comparison of the word-to-word structural organisation among dream reports in REM and non-REM sleep stages is evidently lacking. The analysis of speech as directed word graphs provides a novel, automated method for analysing verbal reports and can be

suitably applied in this regard. In this study, we aimed to investigate the possible underlying structural differences of 125 dream reports converted into word graphs obtained from 19 participants in controlled laboratory awakenings from REM and N2 sleep stages. Using a sliding window method to control for differences in report length, we found that REM graphs were more structurally connected than N2 ones (i.e. words recur with a longer range), and that this connectivity distinguishes REM and non-REM reports with an efficiency comparable to that of report length. Additionally, using cumulative link mixed models we found that: (1) measures of graph connectedness could predict external ratings of dream complexity, and (2) graph connectedness could significantly improve the fit of a model containing report length in predicting dream complexity. These results suggest that REM reports are intrinsically structured in a more connected way compared to N2 reports. They also point to graph connectedness as a promising indicator of dream complexity that can act as a complementary measure to report length.

Key Words: dreams, REM sleep, non-REM dreaming , sleep mentation, dream report.

P12 - MULTISENSORY TRAINING BREAKS MIRROR LETTER INVARIANCE DURING ALPHABETIZATION, AND POST-TRAINING SLEEP MAKES THE LEARNING ENDURE

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Formal education is a standardized way of acquiring knowledge, but the current educational models do not suit everyone. Evidence-based education requires experiments that adapt to the school reality. Here we investigate a phenomenon that affects students at the onset of literacy: the mirror invariance of letters. Mirror invariance occurs when there is no discrimination between symmetrical images, such as a face from the left or right profiles (Pegado et al., 2010). During alphabetization, mirror invariance hinders the students' ability to distinguish mirror letters (e.g. b and d), leading them to write letters with the reverse orientation (Duñabeitia et al., 2010). Research has shown that multisensory teaching strategies can improve literacy (Pegado et al., 2014). Laboratory studies have also shown that post-learning sleep benefits a variety of learning tasks (Diekelmann and Born, 2010). Our naturalistic intervention set out to verify whether multisensory training and sleep can be used in the school setting to accelerate and consolidate the breaking of mirror invariance in letter writing. To date we have investigated 29 children (5-7 years old) at the beginning of literacy acquisition. We implemented a specific 3-week protocol for daily multisensory training during 30 min followed by 2h nap sessions. The children were pre-evaluated for performance in writing mirror letters and were then randomly divided into 4 groups: training followed by sleep (TS); training not followed by sleep (T); neutral training not followed by sleep (NT) and control without training or sleep (C). The groups were balanced for performance in the task of visualizing the letter and then writing it blindfolded (medians at 40% for T, 30% for TS, TN and C). Subjects were tested at 30 days and 120 days on writing letters (either invariant or mirror) using different combinations of sensory modalities. Our results show that multisensory training is very effective in breaking mirror letter invariance during alphabetization: both the T and the TS groups showed nearly 100% of correct performance after 30 days. However, at 120 days the T group showed a major decrease in performance, while the TS group remained near the ceiling of performance. In a test at 120 days in which subjects first visualized the letter and then wrote it blindfolded, TS showed significantly better performance than T ($p=0.060$). The results support the joint use of school-based multisensory training and post-learning sleep to break mirror letter invariance.

Key words: Mirror invariance; mirror writing; post-training sleep; memory consolidation.

P13 - BEHAVIORAL MARKERS OF LIFE HISTORY STRATEGIES MODULATE PHYSIOLOGICAL REACTIVITY DURING PSYCHOSOCIAL STRESS

Victor Kenji M. Shiramizu[1], Hélderes Peregrino A. da Silva[2], Fívia de Araújo Lopes[2] & Maria Bernardete Cordeiro de Sousa[1].

Life History (LH) theory seeks to understand how individuals allocate time and energy into several daily activities. Broad morphological, physiological, and behavioral traits enable an individual to optimize this allocation and these traits are indicators of life history strategies. The stress response system (SRS) is also essential to coordinate behavioral responses as well as to optimize energetic allocation during psychosocial and physical challenges. Recent theoretical models to humans seek to understand how early life influences during the development organize the SRS and if behavioral markers of LH might to modulate physiological reactivity. Therefore, the objective of this study sought to verify if behavioral markers of LH (basic dimensions of attachment styles and sociosexuality) could modulate the reactivity of hypothalamic-pituitary-adrenal (HPA) axis during a psychosocial stressor. 47 men (Mean age = 23.68, SD = 2.95) were submitted to Trier Social Stress Test (TSST) and cortisol levels were measured through saliva samples that were taken immediately before, 10, and 30 minutes after the TSST started. Generalized estimating equations (GEE) showed main effects of attachment-related anxiety and attachment-related avoidance, where both negatively predicted cortisol levels during the TSST. No effect was found for sociosexuality on cortisol levels. The present study supports theoretical models on early life influences modulating the HPA functioning and the relevance of these influences on LH context.

Keywords: Life History Theory; Attachment; Sociosexuality; Psychosocial stress.

POSTER SESSION 2 (FRIDAY)

P14 - SYNCHRONIZATION OF SENSORY AND COGNITIVE PROCESSES TO THE RESPIRATORY CYCLE IN RATS

DOS SANTOS, Elis Brisa and LAPLAGNE, Diego Andrés

Brain activity in vertebrates is characterized by the synchronization of large groups of cells in neuronal oscillations of various frequencies and behavioral or cognitive correlates. In rodents, the sniffing pattern coordinates active sensorimotor behavior and modulates neuronal activity across the brain. The phase of the respiratory cycle is an important time reference for the coding of olfactory and tactile (vibrissae) stimuli. We reasoned that the global modulation of cortical activity by the respiratory rhythm could result in other sensory and cognitive processes— apparently unrelated to respiration—being influenced by the respiratory phase. The present project aims to test this hypothesis by monitoring respiration as rats solve operant behavior tasks. We will implant the rats with cannulae to record intranasal pressure and train them in two tasks: temporal estimation and auditory pitch discrimination. For temporal estimation, rats will be trained to hold their snout in a central nosepoke for a fixed amount of time and then exit within a short time window to receive reward. We will assess whether the respiratory frequency during the trial or the phase of the respiratory cycle at the expected exit time influences the timing of their behavior. To verify if respiration influences auditory perception, rats will be trained to discriminate between brief high and low pitch tones. Rats will initiate each trial by poking in the central nosepoke and, upon hearing the sound stimulus, will have to poke left for low- and right for high-pitched sounds. The difficulty of the task will be controlled by changing the pitch difference between the stimuli. We will analyze whether the phase of the respiratory cycle at the time of stimulus onset influences the reaction time and/or the percentage of correct choices. Positive results would hint that, at least in rodents, the respiratory cycle has a widespread role in coordinating sensorimotor and cognitive processes.

Keywords: Sniffing; Respiratory coupling; Operant behavior; Temporal estimation; Auditory discrimination.

P15 - OLFACTORY BULB DRIVES RESPIRATION-COUPLED BETA OSCILLATIONS IN THE RAT HIPPOCAMPUS

André LV Lockmann, Diego A Laplagne, Adriano BL Tort

The synchronization of neuronal oscillations has been suggested as a mechanism to coordinate information flow between distant brain regions. In particular, the olfactory bulb (OB) and the hippocampus (HPC) have been shown to exhibit oscillations in the beta frequency range (10-20 Hz) that are likely to support communication between these structures. Here we further characterize features of beta oscillations in OB and HPC of rats anesthetized with urethane. We find that beta oscillations simultaneously appear in HPC and OB and phase-lock across structures. Moreover, Granger causality analysis reveals that OB beta activity drives HPC beta. The laminar voltage profile of beta in HPC shows the maximum amplitude in the dentate gyrus, spatially coinciding with olfactory inputs to this region. Finally, we also find that the respiratory cycle and respiration-coupled field potential rhythms (1-2 Hz) – but not theta oscillations (3-5 Hz) – modulate beta amplitude in OB and HPC. In all, our results support the hypothesis that beta activity mediates the communication between olfactory and hippocampal circuits in the rodent brain.

P16 - ON INFORMATION METRICS FOR SPATIAL CODING

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The hippocampal formation is involved in navigation, and its neuronal activity exhibits a variety of spatial correlates (e.g., place cells, grid cells). The quantification of the information encoded by spikes has been standard procedure to identify which cells have spatial correlates. For place cells, most of the established metrics derive from Shannon's mutual information (Shannon, 1948), and convey information in bits/sec or bits/spike (Skaggs et al., 1993; Skaggs et al., 1996). Despite their widespread use, the performance of these metrics in relation to the original mutual information metric has never been investigated. In this work, using simulated and real data, we find that the current spatial information metrics correlate less with the true information content in the data than the original mutual information metric. We propose corrections that yield more accurate and comparable spatial information estimates.

Keywords: Place cell; place field; spatial coding; information; spike train analysis; hippocampus.

P17 - RUNNING SPEED MODULATES DELTA OSCILLATIONS IN THE RAT HIPPOCAMPUS

Pedrosa R, H Belchior, Furtunato AM, ABL Tort.

Neuronal networks in the rodent hippocampus oscillate in many different and sometimes coexisting frequency rhythms according to behavioral states. While theta (5-12 Hz) oscillations are prevalent during active behaviors, like attention, exploration, and also REM sleep, hippocampal delta (1-4 Hz) oscillations appear mostly in quiet and drowsiness behaviors, non-REM sleep and anesthesia. These two rhythms are traditionally viewed as mutually exclusive, and often used to characterize "online" and "offline" hippocampal states. Here we report the emergence of hippocampal delta oscillations while rats increase their locomotion speed in a computer-controlled treadmill. The amplitude and frequency of delta oscillations were strongly associated to the speed of running, and become remarkably periodic above speeds of 30 cm/s. Our results demonstrate that running speed strongly modulates delta oscillations in the rat

hippocampus, and that this rhythm and theta oscillations can coexist and interact with each other.

P18 - MOTION CONTRAST REFLECTED IN GAMMA PHASE-LOCKED VISUAL CORTICAL RESPONSES

Sergio A. Conde-Ocazionez, Tiago S. Altavini, Thomas Wunderle and Kerstin E. Schmidt

Features in the visual context outside the classical receptive field (CRF) can modulate stimulus-driven activity of single cells in the primary visual cortex. This modulation, mediated by horizontal and feedback networks, has been extensively described as variation of firing rate. However, it has been also identified in other neural signatures like pairwise spiking or local field coherence. Yet, evidence about co-existence and integration of such signatures remains elusive. Therefore, we recorded spiking and LFP activity evoked by natural-like stimuli in primary visual cortex of anesthetized cats. We computed firing rates and phase-locking to the low-gamma frequency of single cells and neuronal assemblies, and analyzed their modulation with changes in the direction of movement of the stimulus in the CRF surround. These changes were reflected in all these neuronal signatures, yet in semi-independent populations. Whereas activation of assemblies accompanied single cell rates, their phase relations were modulated differently. Moreover, only the latter measure mirrored the direction of movement of the surround. In agreement, thermal deactivation of visual inter-hemispheric connections selectively affected the context modulation of phase relations. We argue that visual context is reflected in complementary and superimposed neuronal signatures that can represent different surround features in independent neuronal populations.

P19 - CLUSTERING OF ORIENTATION SELECTIVE NEURONS IN AGOUTI VISUAL CORTEX

Dardo N. Ferreiro, Sergio A. Conde-Ocazionez, João H.N. Patriota, Luã C. de Souza, Moacir F. de Oliveira, and Kerstin E. Schmidt

So far, there is no evidence of a columnar organization in rodent primary visual cortex, in contrast to carnivores and primates. However, orientation selective neurons have been found in all rodent species investigated. This opens up the question whether the connectivity underlying the emergence of such cortical response properties follows a different blueprint in animals with interspersed as compared to columnar organization. Also, rodent data are only available for species with nocturnal or crepuscular habits and small brain size, two factors that could contribute to develop a different functional architecture. Here, we set out to compare the functional architecture in primary visual cortex of carnivores and a big rodent of diurnal habits, and comparable V1 size to cats and small primates. To this end, we performed optical imaging of intrinsic signals and multi-site electrophysiological recordings from both anesthetized cats' (Felis catus) and agoutis' (Dasyprocta aguti) visual cortex. Stimuli consisted of oriented gratings of several spatial and temporal frequencies. Although we detected a similar ratio of orientation selective neurons in both species (58% for cats and 62% for agoutis), overall, agoutis presented much smaller orientation selectivity indices (median OSI = 0.10) than cats (median OSI = 0.19). Optical imaging revealed no orientation preference columns for agoutis. In order to describe the functional architecture based on the electrophysiological data, we quantified the orientation preference difference between neurons according to the cortical distance between them. As expected, this analysis revealed a characteristic clustering of neurons with iso-orientation preference at about 1000 um for cats. No such "classical" modularity was found for agoutis, but a clustering of neurons with similar orientation preferences was observed for short ranges (< 250).

P20 - DO OSCILLATIONS OF THE LOCAL FIELD POTENTIAL IN AGOUTI VISUAL CORTEX REFLECT ORIENTATION SELECTIVITY?

Joao H. N. Patriota, Dardo N. Ferreiro, Sergio A. Conde-Ocazionez, and Kerstin E. Schmidt

Orientation selectivity is a common response property of neuronal activity in mammalian primary visual cortex (V1). Even though such different species as carnivores and rodents share that property, orientation selective neurons can organize in different layouts, generating different neural maps. A prominent example is the columnar orientation preference map, found in cats, ferrets, tree shrews and several primates, as opposed to unstructured, seemingly random arrangements commonly referred to as salt-and-pepper configurations observed in small rodents. For animals with a columnar V1 layout there is evidence that the local field-potential (LFP) oscillations are maximal in response to stimuli that match the orientation and direction preference of a local cluster of neurons (Gray & Singer, 1989). In the present ongoing study, we investigate LFP oscillations in the agouti, a big diurnal rodent with orientation-selective visual responses (see Ferreiro et al., companion abstract) but yet unknown functional architecture. In detail, we quantify how theta (4-7 Hz), alpha (8-12 Hz), beta (13-20 Hz) and gamma (20-70 Hz) band power distribute in the visual evoked response. Furthermore, we analyze if the stimulus orientation is relevant for each bands' power. Preliminary analysis suggests orientation selectivity in the Gamma band power. The absence or presence of the feature orientation selectivity in the LFP power could enlighten our understanding of the Agouti's functional organization in V1.

P21 - CHARACTERIZATION OF CHRNA2 AMYGDALA CELLS

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Chrna2 is a gene that encodes the alpha-2 subunit of nACHr (nicotinic acetylcholine receptor). Chrna2 amygdala cells are a subpopulation of neurons that can be target using a Chrna 2/tomato transgenic mouse. This project intends to characterize Chrna2 cells in Amygdala, their role in emotion-related circuits, more specifically regarding ventral hippocampus. It is intended here to disclose these two important brain structures through a more in-depth look at their cellular composition, featuring the circuitry through morphological, electrophysiological and connective profiles. Therefore, several types of experiments are required, such as patch clamp and optogenetics for in vitro electrophysiology; immunohistochemistry and patch-seq for gene expression and protein characterization; virus tracing and dye imaging for morphology identification, recognizing axonal projections and connections. Several types of Chrna2 neurons all over the body have been characterized before, such as Martinotti cells in the cortex, OLM cells in hippocampus and Renshaw cells in spinal chord. Otherwise, Chrna2 Amygdala cells still have not been well characterized in literature, which means that much remains to be done.

P22 - A MODEL OF MEMORY MIGRATION IN THE BRAIN DURING THE PROCESS OF SLEEP-MEDIATED CONSOLIDATION

Silva, A.C.C.; Renno-Costa, C; Ribeiro, S.

Sleep is fundamental to a process known as consolidation in which volatile memories become stable and long-lasting. Recent research has brought innovative results in the field, describing elements and patterns that influence memory consolidation. However, these factors are very diverse: biophysical stimuli, the presence of kinases, the presence or not of elements such as Calcium, the abundance of REM sleep and NREM. These factors help in memory consolidation, however, for so many, it becomes a challenge for neuroscientists to draw a general picture of the process as a whole. The objective of this research is to use machine learning to recognize patterns of memory consolidation and a construction of prediction algorithms that allow inferring

information that is not possible in vivo. We manipulate a reference model of the ventral visual hierarchy by introducing a sleep algorithm and evaluate how the learning process and the learned representation are enhanced. The reference model of our choice sits at the borderline between machine learning and neuroscience. The model is based on a multilayer neural network that is connected to a visual input (CCD camera) in its first layer. The camera is attached to a small robot that randomly explores the space to be mapped. During the exploration, a self-organizing learning process acting over the vertices weights guarantees that, after some time, a stable and position-specific population representation of the environment is observed in the top layer of the network. With this model, it is possible to isolate information, remove noise and draw a functional pattern of how memory is consolidated in the different stages of sleep also considering temporal aspects.

P23 - DEPTH VIDEO RECORDING FOR MONITORING RODENT BEHAVIOR

Davi Drieskens Carvalho, Geraldo Drieskens Carvalho dos Santos, Elis Brisa dos Santos, Joseph Andrews Alves, Diego Andrés Laplagne

Ethology has shown how animal behavior can be described with 'ethograms': sequences of transitions between a limited number of stereotyped patterns or 'modes'. Behavioral scientists have traditionally built these ethograms by observation and manual annotation. Currently, efforts are being made to automatize the classification of behavior through computer vision and machine learning. Depth video recordings are a valuable tool for this, as they provide detailed information on the pose of the animals. Here we recorded depth videos of freely moving rats at 30 frames per second and 512x424 pixels resolution with Kinect 2.0 (Microsoft, < US$ 100) using custom-made software based on the Kinect for Windows SDK 2.0. In this way, we obtain height profiles of the rats with a depth resolution of 1 mm from which the pose of the rat can be analyzed at each frame. We will implement unsupervised machine learning algorithms to obtain the rat ethogram from these depth recordings.

P24 - QUANTITATIVE GRAPH ANALYSIS OF MARMOSET DIALOGUES

Ignacio Sánchez-Gendriz, Sidarta Ribeiro

A key question for the biology of language is to determine which aspects of complex human language are shared by other animals. Common marmosets (Callithrix jacchus) are highly vocal new world primates of major interest for the study of vocal communication. Speech graph analysis in humans has been successfully used by our research group to provide quantitative markers of psychosis, Alzheimer's disease and alphabetization. In the present study we aim to characterize the structure of marmoset dialogues, with the future goal of assessing and disturbing it in future studies of speech disorder models. Here we set out to investigate 8 common marmoset adults housed in three adjacent cages (N=2, 4 and 2) exposed to natural light and housed in a naturalistic manner. Multiple cameras and microphones will be placed inside each cage to allow for the identification of type call and emitter identity at every vocalization uttered. Graph analysis will be used to reconstruct the dialogues in a comprehensive manner, so as to mathematically characterize the natural structure of marmoset dialogues.

P25 -EFFECT OF LEVETIRACETAM ON SYNAPTIC HIPPOCAMPIC PLASTICITY OF RATS WITH TEMPORAL LOBE EPILEPSY IN THE CHRONIC PHASE.

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Epilepsy is a disease profoundly disabling and devastating that affects severely to the patients. In México, in 2004 there were approximately 1.5 millions of patients with epilepsy. Temporal lobe epilepsy (TLE), a kind of epilepsy with focal origin affects synaptic plasticity of the perforant pathway- hilus of the gyrus dentate circuitry, producing important learning and memory deficits. It has been observed that levetiracetam (LEV) prevents such learning and memory impairments, as it restores synaptic plasticity when administrated during epileptogenesis. In this study, it will evaluate the effect of LEV on synaptic plasticity of hippocampal networks in chronic epileptic rats. Precisely, we will quantify the long-term potentiation in the perforant pathway-granule cell synapsis in an animal model of temporal lobe epilepsy. Methodology: The lithium-pilocarpine model for TLE in Wistar male rat was used, where it was determined the effect of LEV on hippocampal synaptic plasticity by mean of electrophysiological records of evoked field potentials. Results: During the stabilization protocol, evoked extracellular post-synaptic potential (EPSP) stabilized in 40 minutes for control but not for epileptic rats. Input-output (I/O) curve, with different stimulus intensity, exhibited a linear increase of the EPSP slope and population spike amplitude depending on the stimulus intensity. However, epileptic rats did not show this increment. On the other hand, the profile of paired-pulse depression and facilitation was altered in epileptic animals, since control group presented a substantial depression, but not facilitation, of the population spike at 70 ms interval, as reported previously. Conclusions: During the standardization of evoked field potentials recordings, the I/O curve in epileptic rats was altered concerning the control group Nevertheless, is necessary the inclusion of more data to determinate the complete description of this phenomenon. Financing funds: Federal financing INP-064/2015 and SEP-CONACyT 1800069 grant.

P26 - ROLE OF REM SLEEP IN THE CORTICALIZATION OF A HIPPOCAMPUS-DEPENDENT MOTOR MEMORY

Patrícia Pauli, Claudio Queiroz, Sidarta Ribeiro

Several lines of evidence indicate the participation of REM sleep in the consolidation of procedural and hippocampus-dependent memories. In the latter, it has been suggested that memory trace undergoes a progressive disengagement of the hippocampus (HPC) and engagement of neocortical structures over time. Among the regions of the neocortex involved in this consolidation process, the anterior cingulate cortex (ACC) is one of the most important, and is required for remote long-term memory retrieval. In fact, it was recently shown that REM sleep promotes synaptic remodeling in the primary motor cortex (MC) after motor learning in mice. This project aims to assess the influence of REM sleep on spontaneous and event-triggered neuronal activity recorded before, during and after training in a hippocampus-dependent active avoidance task, in which air puffs make mice learn to avoid a specific sector of a rotating circular arena. The mice will receive movable tetrodes in the HPC, and single-wire arrays in the ACC and MC. Up to now, we have conducted a pilot experiment to test the efficacy of air puffs as an aversive conditioning stimulus (N=4). A rectangular arena (38x16x15cm) was longitudinally divided into 5 equally-spaced segments. Air puffs (~0.1 atm, ~0.8 sec duration and ~0,8 sec of interval between stimulus) were delivered every time the animal entered the center sector with its four paws. Animals were exposed for two 10 min habituation sessions separated by 90 min each other, followed by two training sessions of 10 min and separated by 90 min of the habituation and each other. During training sessions mices received the unconditioned stimulus 'air puff' in the middle segment, which association (context + air puff) formed a contextual aversive memory. Mices were tested 90 min after second training for 10 min without air puff and were retested (10 min) 24 hour posteriorly the test. In average, animals received 87,25¤11,63 (mean±SEM) air-puffs in training trial 1 and about 58,75±7,69 (mean±SEM) in training 2.

On the test session, we quantified the number of entries in the aversive sector, the latency for the first entry in the conditioned sector, the amount of time spent in the aversive sector. When tested 90 min after training, the number of entries in the center sector decreased 64,5% (paired t-test t[3]= 3,1824; p< 0.001) when compared with habituation1 and decreased 62% (paired t-test t[3]= 3,1824; p= 0.0066) in comparison to the habituation 2. The latency to enter the first time in the center sector increased 97% (with no statistically relevant difference; paired t-test t[3]= 3,182; p=0,0652) and 77% (no statistically relevant difference; paired t-test t[3]= 3,182; p=0,0677) compared with habituation 1 and 2, respectively. Interestingly, this aversive contextual memory did not persist when tested 24 hours after learning in test 2, probably because the test 1 extinction. We observed correlation between latency to enter the first time in the sector and the number of air puffs just for training 1 (r= -0,9226), on the other hand we had no correlation between number of entries in the sector and the number of air puffs of any training. Next step is make another pilot experiment to evaluate different intensities (in atm) of air puff and intervals between training and test looking for one which make possible retain memory for long days to study remote long-term memory with this stimulus in the rotating active avoidance apparatus. We are now building this rotating active avoidance apparatus to investigate the role of REM sleep in the corticalization of a hippocampus-dependent motor memory. The following experiments are planned: two habituation (without air puff) sessions of 5 min with 10 min of interval between each other in the first day, followed by five sessions training (with air puff in a sector of apparatus) with 5 min duration and 10 min interval between each other in the second day. One group will be subjected do test 5 hours after last session of training, other group will be subjected to test 42 hour and another group 14 days after last session of training. The test session consists in expose the animals in the context without air puff. All this group will be repeated with sleep and REM privation 0-4 hour and another with sleep and REM privation 10-16 hour after last session training to analyze the role of REM in short-term memory, recent and remote long-term memory. The electrophysiology register will be 2 hours before, 4 hours after and during each session of training and test. Besides that, we will register over diary 8 hours during clear phase after last training session, which is a god temporal window for consolidation.

P27 - A ROLE FOR FEEDFORWARD INHIBITION IN REGULATING FIRING SYNCHRONY AND COMPETITION MEDIATED BY FEEDBACK INHIBITION

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Feedback inhibition underlies a competitive mechanism in which neurons with strong excitation are selected to fire. The selection process can be approximated as an E%-max winner-take-all process with an excitation threshold set as a fraction of the highest level of excitation in the population. The excitation threshold is configured as a ratio of the accumulated energy of individual neurons before the inhibitory current becomes effective. As the time between the first spikes in the excitatory population and the onset of the inhibitory current is invariant and the rate by which neurons accumulate energy is dependent on the level of excitation, the level of competition depends on the overall excitation strength. Moreover, the power of excitatory input critically affects the frequency of network oscillation in the gamma range which is in contradiction with the fact that theta modulation of the input stream only mildly changes the overall population rate. Here we argue in favor of a critical role for feedforward inhibition capability to normalize the input excitation in the regulation of feedback inhibition-mediated competition and synchrony of associated neurons. Using computer simulations, we show that, with the addition of a linear inhibitory component proportional to the average populational excitatory strength, a canonical model with feedback inhibition can produce gain-invariant competition and synchronous oscillation. As feedforward and feedback inhibition co-occur in many brain regions, the interplay

between these two forms of neuronal interaction likely underlies a general computational principle widely applicable in the brain.

P28 - COMPUTING THE EFFECT OF NEURONAL POPULATION SIZE IN THE COMPETITION BETWEEN CELLS TO FIRE DURING A GAMMA FREQUENCY CYCLE

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The oscillatory dynamics evoked by feedback inhibition underlies a competitive process that selects which cells fire. Different models have shown how such competitive process support different input-output transformations observed in electrophysiological data. Here we use computational modeling and simulation techniques to evaluate whether the number of cells has any effect on the competing process. We base our work on recently published data that describes in detail the connectivity and molecular properties of granule cells and interneurons in the Dentate Gyrus. We incorporated these features in a reference canonical model of the Dentate Gyrus and evaluated whether changing the number of cells affects how the competition takes place.

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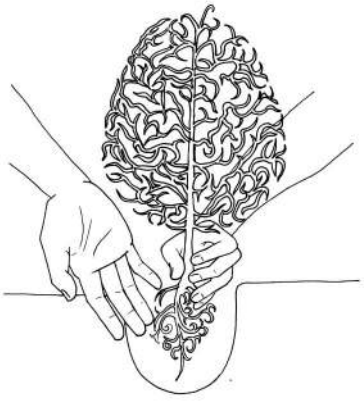

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