International Conference on
Neurophysiology, Neuropsychology and Neurotechnological advances

Scientific Program

Friday, 21st June

16:00	Opening, by Fernando Maestú
16:20	Oral Communications: Pathological Aging
17:00	Coffee Break
17:20	Oral Communications: Pathology / Binge Drinking
18:00	Coffee Break
18:15	Oral Communications: Computational
18:45	Coffee Break
19:00	Oral Communications: Cognitive Psychology

Saturday, 22nd June

11:00	Oral Communications: NASA
11:20	Coffee Break
12:00	Talk, by Frank Zanow
12:45	Coffee Break
13:00	Talk, by Carlos Javier Gómez Ariza

I-C3N 2024

Abstract Booklet

Friday, 21st June

Opening

16:00. Fernando Maestú. Multi-network system for understanding human representations

Pathological Aging

16:20. Blanca P Carvajal. Functional excitation/inhibition imbalance in mild cognitive impairment

16:30. Soraya Alfonsín. AI-Mind: current state of the study and CANTAB as a neuropsychological assessment tool

16:40. Marcos Uceta. Effects of neuroinflammatory impact during neurodevelopment on the onset and development of Alzheimer's disease: a state of the art review

16:50 Lucía Hernández. Thematic analysis of cognitive deficits in mild cognitive impairment: preliminary results

Pathology / Binge Drinking

17:20. Héctor Peribáñez. Cerebral ventricular enlargement is associated with power abnormalities in theta and gamma band in healthy aging and MCI

17:30. Irene García. Molecular causes of DFNB16 non-syndromic hearing loss: new mutations and genotype-phenotype correlation

17:40. Alberto del Cerro. Electrophysiological network follow-up in adolescent binge drinkers

17:50. Danylyna Shpakivska. Is successful response inhibition modulated by transient beta bursts?

Computational Models

18:15. Vincenzo Fiore. Exploring Plasticity in the Entorhinal Cortex of MCI Patients Through Computational Modeling and Neuromodulation

18:25. Adelia-Solás Martínez. Machine learning models for identifying ADHD

18:35. Francisco Rodríguez. Application of AlphaZero to a 13th Century Game

Cognitive Psychology

19:00. María Villar. Suppression-induced forgetting and mental health: to replicate or not to replicate

19:10. Aimée Reyes. Exploring the relationship between active forgetting and differences in resting-state functional connectivity measures. An experimental study.

19:20. Claudia Cogollos. Suppression-induced forgetting and depressive rumination: a behavioural and EEG study.

Saturday, 22nd June

NASA

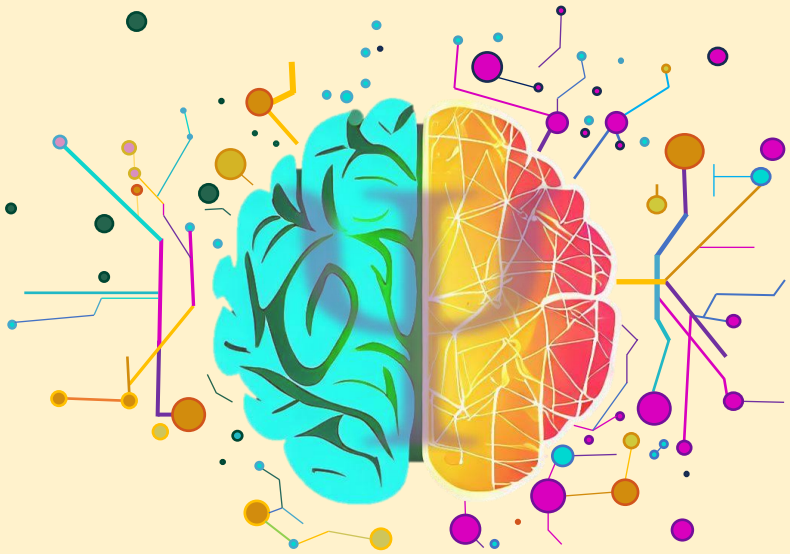
11:00. María Sevilla. Spaceflights vs. Head-Down Tilt Bed Rest: A Brain Functional Connectivity Approach

11:10. Adrián Quivira. Relative power evaluation: contrasting data from head-down tilt bed rest and spaceflight conditions

Talks by our Keynote Speakers

12:00. Frank Zanow. Applications of EEG in neuroscience and mental health

13:00. Carlos Javier Gómez Ariza. Semantic integration and anterior temporal lobe: Convergent evidence from three independent studies by using the same tDCS protocol but different cognitive tasks



Opening Talk

Multi-network system for understanding human representations

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Psycholgist have typically, tried to evaluate cognition trough cognitive task. With that strategy they were having full control on stimuli, task, and participants performance. Majority of human models of cognition are then based on the level of performance of task. This approach were used with lesions, behavioural or neuroimaging studies. However, what is the cognitive system dpoing whrn we are not facing with an external or internal specific stimuli? furthermore what are the neural mechanisms used for consolidate the information in our long term representations? in this talk I will try to put together the ideas of what are the networks that are mediating between stimuli and representation neural mechanisms. Let´s see what comes out of it...

Keywords: functional networks, resting state, human representations

Functional excitation/inhibition imbalance in mild cognitive impairment

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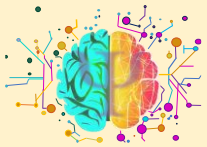
Alzheimer's disease (AD) is a chronic, progressive neurodegenerative disorder. In animal models, it has been characterized by a progressive loss of excitation/inhibition (E/I) balance due to the toxicity of amyloid and tau proteins, which leads to brain hyperexcitability in electrophysiological recordings. However, a direct link between these underlying pathological mechanisms and magnetoencephalography or electroencephalography (M/EEG) recordings in human AD patients remains unclear. The CRCNs project aims to account for differences in MEG signals between patients with mild cognitive impairment (MCI) who convert to AD (CONV) and those who remain stable (NOCONV). This is achieved through computational modeling of neuronal networks and integrating these predictions with MRI data and functional E/I balance measurements. Methods to quantify E/I ratios in human brain networks are limited. We are currently utilizing the Bruining et al. (2020) algorithm to derive a functional E/I ratio (fEI) from neuronal oscillations, based on critical brain dynamics.

Keywords: AD continuum, Criticality, MCI, MEG, fEI



AI-Mind: current state of the study and CANTAB as a neuropsychological assessment tool

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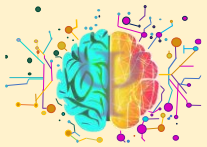
The European AI-Mind study aims to enhance early Alzheimer's diagnosis using neuropsychological assessment, blood biomarkers (p-tau and ApoE) and electroencephalogram (EEG). Over 1,000 participants have been recruited across four countries: Norway, Finland, Italy, and Spain. These participants are evaluated every 8 months for 2 years to observe longitudinal changes during this period. In Spain, 267 individuals with mild cognitive impairment (MCI) aged between 60 and 80 years have been included and are attending subsequent visits. One of the assessment tools used is the Cambridge Neuropsychological Test Automated Battery (CANTAB), featuring a subset of 7 tests that evaluate processing speed, episodic visual memory, visual recognition, sustained attention, working memory, and planning. Additionally, these cognitive skills are assessed using a widely validated battery of classical neuropsychological tests. We aim to study the correlation between performance in the different cognitive domains across both evaluation modalities.

Keywords: AI-Mind, Neuropsychology, Cognition, CANTAB, Evaluation



Effects of neuroinflammatory impact during neurodevelopment on the onset and development of Alzheimer's disease: a state of the art review

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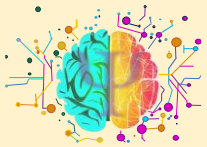
The study of lifestyle in relation to neurodegenerative diseases is becoming more frequent, with the consumption of certain neuroinflammatory substances being a significant factor in the early onset of diseases such as Parkinson's and Alzheimer's (AD). Thus, increasingly widespread consumption patterns, such as intensive alcohol consumption (Binge Drinking, or BD), may pose a substantial risk in accelerating the onset of classic AD dysregulations, especially in those genetically predisposed to such disorders. In this work, I will present the state of the art of our project developed over the past year, where, using transgenic animal models of AD, we characterize whether there is an impact of BD during neurodevelopment in the onset and development of AD. We focus specifically on the interneuronal networks within key areas of the disease, including the characterisation of PV+ Lamp5 interneurons, glial cells reactive to proinflammatory factors and perineural networks surrounding these cells.

Keywords: AD, Animal models, immunohistochemistry, Binge Drinking, neuroinflammation



Thematic analysis of cognitive deficits in mild cognitive impairment: preliminary results

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One of the diagnostic criteria for Mild Cognitive Impairment (MCI) is to have functional abilities preserved. However, the cognitive deficits may be related with subtle decline of these skills, such as committing more errors, or becoming slower or less efficient. The large amount of inter-individual differences in cognitive and functional deficits make it difficult to analyze the more subtle aspects of daily living with MCI. Therefore, our aim is to capture those subjective aspects of the disease. In this research, a qualitative study is carried out through in-depth individual semi-structured interviews of the cognitive deficits of 12 people with MCI, in order to typify their experiences and identify commonalities that could help to develop more personalized therapeutic interventions.

Keywords: Mild cognitive impairment, functional abilities, cognition, thematic analysis, qualitative study.

Cerebral ventricular enlargement is associated with power abnormalities in theta and gamma band in healthy aging and MCI

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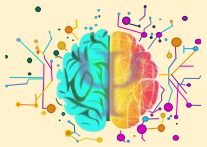
Cerebral ventricular volume enlargement is associated with the onset and development of dementia. Thus, it is essential to characterize the physiological and structural features associated with this marker in healthy population and different stages of cognitive impairment. For this purpose, we used magnetic resonance imaging and magnetoencephalography recordings of 391 (51-87 years old), of which 99 were diagnosed as mild cognitive impairment and 292 were used as controls. Accordingly with previous results, it was found that the size of lateral ventricles was linked with a significant increase in the theta band (4-8 Hz) power within temporo-parietal regions and a decrease in the gamma band (30-45 Hz) power in medial frontal and parietal regions. Additionally, it was found that the volume of the ventricles presented a close association with cortical deterioration signs in the temporal lobes and insula as well as with the integrity of different white matter tracts.

Keywords: Aging, MCI, MEG, MRI, Ventricle volume



Molecular causes of DFNB16 non-syndromic hearing loss: new mutations and genotype-phenotype correlation

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Non-syndromic hearing loss (NSHL) is a very heterogeneous genetic condition, involving over 150 genes. Mutations in the STRC gene, responsible for the DFNB16 type of autosomal recessive SNHL, are a common cause of moderate hearing loss. STRC is located in a tandem duplicated region that includes the unprocessed pseudogene STRCP1, with a high percentage of identity with the gene (>98%). For this reason, the region is prone to rearrangements that generate structural variations. We analyzed two Spanish cohorts: 117 familial cases and 35 sporadic cases. Several techniques were used to find point mutations and deletions involving STRC (amplification of the D15S784 marker, massive sequencing, MLPA, and long-range gene-specific PCR followed by Sanger sequencing). Causative variants in STRC were found in 17 cases. All affected subjects had moderate hearing loss. Our results support this strong genotype-phenotype correlation and highlight the significant contribution of STRC to moderate NSHL in the Spanish population.

Keywords: Hearing loss, mutation, phenotype, genotype, non-syndromic

Electrophysiological network follow-up in adolescent binge drinkers

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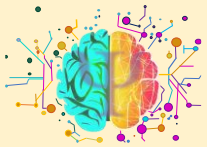
Alcohol consumption during adolescence has been associated with neuroanatomical abnormalities and the appearance of future disorders. However, the latest advances in this field point to the existence of risk profiles which may lead to some individuals into an early consumption. Based on structural and electrophysiological data, we constructed a predictive model of alcohol usage in adolescents who had not yet initiated consumption. In relation to alcohol consumption, it was found that those young people who consumed alcohol more intensively presented hyperconnectivity in certain networks throughout all the frequency bands analyzed (Theta (4-8 Hz), alpha (8-12 Hz), low (12-20 Hz) and high beta (20-30 Hz) and gamma (30-40 Hz)). Finally, monitoring of functional connectivity in these networks showed that there was an increase in functional connectivity that correlated inversely with alcohol consumption. These results may indicate that electrophysiological features associated with early consumption may be related to neuromaturational differences in functional networks during adolescence.

Keywords: Alcohol, Functional connectivity, Follow-up, Adolescence



Is successful response inhibition modulated by transient beta bursts?

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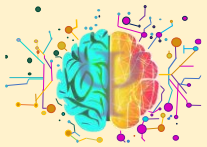
The ability to inhibit an already initiated motor response is a key component of executive functions and is a common deficit in major psychiatric disorders. M/EEG studies of response inhibition tasks have shown that increased beta and gamma power in the right inferior frontal cortex (rIFC) and the pre-supplementary motor area (preSMA) following a no-go stimulus predicts successful motor cancellation. However, recent single-trial analyses of time-frequency data suggest that neural activity in these frequencies can be explained by transient, isolated burst events. To investigate this phenomenon, we studied a sample of N=80 healthy subjects using magnetoencephalography while they performed a 70-30 Go/No-Go task. We propose that an increased expression of transient beta events in these cortical areas, characterized by their frequency, power, rate, and duration, could be the underlying mechanism explaining successful inhibitory control in humans.

Keywords: Inhibitory control, beta burst, inferior frontal gyrus, Go/NoGo



Exploring Plasticity in the Entorhinal Cortex of MCI Patients Through Computational Modeling and Neuromodulation

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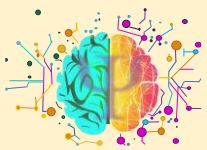
The entorhinal cortex, part of the hippocampal formation, controls cortical and subcortical afferents to the hippocampus. Crucial for memory, it is among the first affected by tau protein deposition in Alzheimer's disease (AD). Recent studies show early alterations in the entorhinal cortex in patients with mild cognitive impairment (MCI) who are fast converters. Our work aims to demonstrate, through computational modeling, the atrophy of neuronal fibers in the entorhinal cortex in MCI patients. Using Spiking Neural Networks to reconstruct the neural network involving the entorhinal cortex, we assess potential plasticity following the application of external electromagnetic fields via neuromodulation. The entorhinal cortex is targeted due to its early involvement in AD, allowing for preclinical intervention, thus maximizing neuronal plasticity and protection against pathology. Additionally, its regular geometric shape facilitates accounting for the effects of electric fields on these areas.

Keywords: entorhinal cortex, Alzheimer's disease, mild cognitive impairment, spiking neural network, neuromodulation



Machine learning models for identifying ADHD

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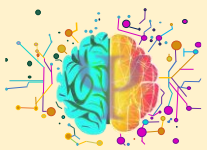
Background: Current diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) is a challenging process focused on questionnaires and clinical interviews, which could be sensitive to subjective biases (Farone et al. 2005). In this study we used machine learning algorithms (ML) to explore objective measures such as cognitive assessments to reduce time and resources for ADHD diagnosis. Methods: Data from the Child Mind Institute dataset (Alexander et.al, 2017) was used, analyzing 145 children (77 ADHD, 68 controls) aged 8-11 years. The included variables were cognitive assessments (NIH, WIAT, WISC), resulting in a total of 29 features. Results: The best classifier was gaussian Support Vector Machine (SVM), with 73.3% accuracy using 5 features selected by LASSO. Comparison of training and test results reveal that overfitting was successfully avoided. Conclusion: The time and resources needed for ADHD diagnosis may be reduced by using cognitive assessments combined with ML techniques, reaching a moderate accuracy.

Keywords: ADHD, Machine learning, cognition, neuropsychology



Computational modelling alpha activity from MEG resting state data: model development and characterization

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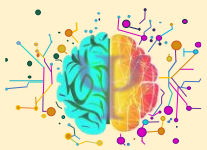
Computational models of brain activity are increasingly utilized to investigate the mechanisms underlying brain diseases, test novel stimulation protocols, and assist in planning surgical procedures. These models typically integrate diffusion-weighted MRI data to construct structural connectivity matrices, combined with neural mass models that simulate neural activity at the regional level. While regional models have been extensively characterized with respect to electrophysiological data, comprehensive characterizations at the whole-brain level remain elusive. In this research proposal, we aim to develop, parameterize, and characterize a biologically inspired brain network model of alpha activity. By leveraging empirical MEG recordings from resting states with eyes open and eyes closed, we will deepen into the mechanisms that generate and attenuate alpha oscillations. Our investigation focuses on understanding how alpha waves are generated and propagated within the brain, and how sensory stimuli modulate the power of these oscillatory behaviours. To thoroughly characterize the proposed model of alpha activity, we will examine whether its parameterization at criticality exhibits the electrophysiological hallmarks of critical brain activity, such as chaotic dynamics and neuronal avalanches. Furthermore, we will explore the impact of structural connectivity on the emergence and characteristics of alpha rhythms. This research aims to bridge the gap in whole-brain model characterizations, providing insights that could enhance our understanding of brain function and dysfunction.

Keywords: Brain simulation; Computational Neuroscience; Alpha; Electrophysiology



Application of AlphaZero to a 13th Century Game

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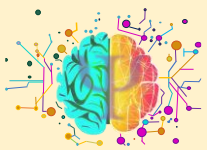
AlphaZero is a Reinforcement Learning model widely considered as one of the greatest achivements involving Artificial Intelligence in the 21st century, due to the fact that it is able to learn to play complex games without any human interaction, just by playing against itself. The objective of this work is to evaluate its efficacy at a lower computing scale, by testing it against the thirteenth century game Alquerque de Doce, predecessor of draughts. The result is an artificial agent capable of playing in an effective and aggresive style, comparable to human players.

Keywords: Reinforcement Learning, Deep Learning, Convolutional Neural Networks, Game Theory



Suppression-induced forgetting and mental health: to replicate or not to replicate

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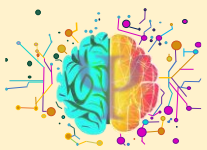
Latest research in Cognitive Neuroscience has shown that forgetting is an adaptive capacity that allows us to regulate the accessibility and impact of our memories, ensuring proper functioning of the cognitive-emotional system. The Think/No-Think (TNT) paradigm, where participants actively avoid recalling an unwanted word associated with a cue, shows how cognitive inhibition processes can downregulate the accessibility of an undesired memory, a phenomenon known as suppression-induced forgetting effect (SIF). Nevertheless, there is contention regarding the robustness and magnitude of this effect, as several studies couldn't replicate it. A recent meta-analysis suggests that the SIF effect size may be smaller than reported, partly due to publication bias. Therefore, The Memory Control Consortium, has conducted a replication study of the TNT paradigm, with the two most common instructional variants (Thought Avoidance and Thought Substitution). Here we present one of the Spanish datasets, besides correlations between SIF and mental health factors.

Keywords: active forgetting, memory, inhibition, replication, emotional regulation



Exploring the relationship between active forgetting and differences in resting-state functional connectivity measures. An experimental study.

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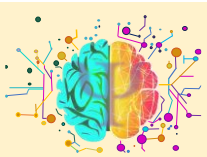
Motivated forgetting refers to the reduction in memory recall as a result of inhibitory mechanisms and is related to the adaptability of the memory system. Specifically, forgetting during retrieval can be observed in the suppression-induced forgetting (SIF) effect, which is studied using the Think/No-Think (TNT) paradigm. The literature suggests a relationship between resting-state functional connectivity measures and the SIF effect. The aim of this experiment is to observe whether the ability to forget, in relation to performance on the TNT task (SIF effect), has a direct or inverse relationship with differences in the dynamics of the resting state networks. To this end, the resting-state activity of 48 healthy Spanish university students was recorded using electroencephalography (EEG) for 10 minutes. To analyze the relationship between these two measures, a cluster-based permutation test is planned to identify clusters that significantly correlate with the forgetting measure.

Keywords: Default mode network, Resting state, Electroencephalography, Suppression-induced forgetting, Think/No-Think.



Suppression-induced forgetting and depressive rumination: a behavioral study for an EEG study.

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High ruminators and people with subthreshold depression seem to experience decreased suppression-induced forgetting (SIF), which would make unpleasant memories accessible, and individuals more vulnerable to depressive symptoms. However, other experiments have reported regular forgetting even in depressive patients. A study was conducted comparing low-ruminators without dysphoria (LRnD), high ruminators without dysphoria (HRnD) and high-ruminators with dysphoria (HRD), to clarify the relationship between rumination, depressive symptoms, and SIF of unwanted memories. Initial findings showed that HRnD, HRD and LRnD groups achieved similar SIF effects and were equally able to reduce intrusions during the task. These results challenge the notion that rumination and depressive symptoms are linked to reduced SIF.

Keywords: intrusive memories, retrieval suppression, depression, rumination, inhibition

Spaceflights vs. Head-Down Tilt Bed Rest: A Brain Functional Connectivity Approach

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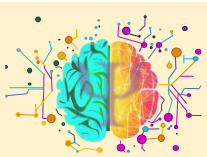
During space travel, the central nervous system (CNS) encounters various environmental stress factors, with microgravity being the primary influence on the brain. On Earth, head-down tilt bedrest (HDBR) is commonly used as a spaceflight analog, mimicking the effect of microgravity on the human body. We have studied how the brain functional connectivity (FC), calculated from electroencephalography (EEG) recordings, is affected during spaceflights and HDBR experiments. FC data from the NEUROSPAT experiments (5 male astronauts) were compared with data from HDBR experiments (21 male participants) across different neural networks. Our analysis concluded that the brain exhibits an adaptive response to the microgravity environment, showing a beta increase in FC in the prefrontal cortex; that a low number of electrodes is insufficient to accurately calculate FC; and that the HDBR analogue captures EEG dynamics that differ from those in microgravity.

Keywords: Spaceflight, FC, EEG, Microgravity, HDBR.



Relative power evaluation: contrasting data from head-down tilt bed rest and spaceflight conditions

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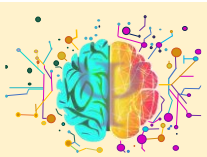
In space, astronauts have to adapt to novel and adverse conditions such as microgravity, which causes a movement of the cerebrospinal fluid (CSF) and the brain to the upper part. To study how these changes may affect human physiology, a -6-degree head-down tilt bed rest (HDBR) method is commonly used as terrestrial analog. Here, looking for similarities between space and HDBR, we have compared two datasets: one with 5 astronauts, and another with 21 individuals that participated in a HDBR experiment. Our results showed some dissimilarities between both datasets. The HDBR principally showed statistically significant increases in delta and theta power during the bed rest, while the astronauts showed a significant increase in beta power during the flight in the somatosensory cortex, leading to the idea of a possible movement-related adaptative response to the altered gravitational environment. Further analyses are needed to understand the implications of these findings.

Keywords: space, microgravity, HDBR, power, EEG



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